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The Challenges of Farming Systems in Bangladesh in the Post Globalization Period

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Abstract

The liberalization policies initiated over the last two decades have resulted in major changes that have affected farming systems structures and dimensions. The impact is causing further marginalization of resource poor farmers. They are becoming more dependent on external resources. As a result they are experiencing many negative impacts such as technology divide, losing age olds social capitals, cultural integrity, sustainable lifestyles practices, and depletion in natural resource base including destruction of soil fertility and local biodiversity.

Integration of subsistence farming systems with domestic and global market geared by poor governance has led to the making farming systems more vulnerable and risky. To respond to the market demand, farmers have to change the components (sub-sectors) of the farming systems very frequently. It is often making farming less sustainable and productive. It has deprived employment opportunities for resource-poor farmers and made vast number of people landless. Some actions that could emanate are designing pro-poor development policies, empowerment of rural communities, particularly women, good participatory governance especially at local level, access to information and knowledge based farming systems, public-private-NGO-Farmers partnership, microfinance and farmer –market direct linkage as part of the complex development process to achieve national development and international commitments like MDGs.

Introduction

Farming system in Bangladesh has undergone fundamental changes over last three and a half decades and entered into the post-globalization period from pre-green Revolution of late 50s through green revolution of late 60s, liberalization period of 80s and globalization of 90s. Agriculture in Bangladesh is still basically farming system based and household based activities to maintain family food security and livelihood throughout the year. Basic characteristic of Bangladesh agriculture - it is dominated by small and marginal farmers. During the pre-green revolution period, farming systems of Bangladesh were reasonably balanced and sustainable but productivity was low. It was highly diversified, complex and dynamic which helped farmers to cope up with natural disasters and to make it round the year profession. Vast natural resources and biodiversity, huge water bodies and indigenous knowledge of the farmers were the main resources to run their farming systems. However, high population growth rate, three percent per year during 50s and 60s, considered starting point for the farmers to switch over from household food security to yield maximization to feed the new entities of their families. Food poverty was not that acute as income poverty during that period.

Pre-Green Revolution Period

Farming system of that period was reasonably balanced and was directed towards achieving family needs to ensure the food security of the farm family. Majority of the farmers mainly produced their goods for their own consumption. Faming system was a unit of both production and consumption. It was low input, low output and subsistence type of farming systems. In general, homestead + crops + livestock was the major farming system and plenty of fishes were available from natural and other water bodies.

Cropping pattern and its diversity were the main determinants of any farming systems to judge the economical, social and ecological strength of a farm family. In addition to rice, minor crops, cash crops and pulses were the integral parts of the cropping pattern. Livestock

was dialectically integrated with cropping systems. Manifestation of it can be seen from the per caput calorie intake in the years 1962-64 which was 2,301 kcal. It indicates that food poverty was not an issue at that period. Farming systems irrespective of farm categories were in conformity with nature and was reasonably sustainable. Population growth which was 3 percent annually in the 60s and fragmentation of land holdings as consequence of population growth put farming in more challenging situations to feed the new family members. Added to this was the increasing frequency of natural disasters. In that situation, farmers had no options except to search alternative to increase the productivity of their farming systems. Similar situation arose across the Asia and other parts of the world.

Green Revolution Period

Seed + fertilizer+ irrigation technology and later on pesticides under the banner of Green Revolution were introduced in Bangladesh in mid-60s as a remedy to overcome the farmers crisis facing by them in marinating their household food security. Green revolution technology was undoubtedly help in increasing food grain production in Bangladesh and thus ensures food security at national level to some extent. Lack of appropriate policies, extremely inadequate infrastructure facilities, war ravaged economy, farmers' poor capacity to adopt the technology within their age-old farming systems environment and almost nil extension services were considered main obstacles to get the benefit of Green revolution technology by the poor farmers. For their own survivability and food security, poor farmers tried their level best to adopt these technologies in order to enhance their food security and income security as well. Later on, it was revealed that Green revolution technology was more suitable to farming systems practiced in favourable agro-ecosystems rather than un-favourable and rainfed ecosystems where most of the resource poor farmers live.

Disintegration of farming systems towards crop sub-sector and bringing more land under crop sub-sector from previously used under fisheries sectors was observed as measures to increase food production and thus ensure household food security. It is now clear that Green revolution accelerated further marginalization of small and marginal farmers to landless and made their farming systems more vulnerable and less ecological sustainable. Fish availability and production drastically reduced during this period.

To sum up it can be concluded firmly that Green Revolution by-passed the farming systems of un-favouable and rainfed ecosystems and due to that it was unable to solve the problems of both food and income security. Both food poverty and income poverty increased during this period in spite of considerable increase in food grain production. Cropping patterns became more mono-cropped based and as a result production of pulses, oilseeds, cash crops and minors crops reduced considerably. Mono cropped (rice) based cropping systems made farming systems more vulnerable and risky. As an outcome of whole scenario, country witnessed the emergence of non-farm sector and transfer of resources from farming systems to non-farm sector.

Post –Green Revolution Period

Wide range of policy reforms of the 90s aimed at moving towards an open market economy have been affecting farming systems both directly and indirectly. Gap between rich and poor farmers are widening and most of the benefit of globalization are being captured by the rich farmers. Farmers practicing subsistence farming find globalization as disadvantageous and even unacceptable to them. They could not overcome the problems created for them during

green revolution rather it has been further aggravating. Changes in the policies have been shown in the **Table no.3.** Some the issues are discussed below:

Changes in the Land Holdings :The reforms in the early 90s were particularly aimed at moving towards an open economy and markets. This put poor farmers in more difficult conditions. Out of 17.83 million households in Bangladesh, 11.80 million households directly involve in agriculture (1996 census). Landless (maximum 0.20 ha of land), marginal (maximum 0.60 ha.of land) and small farmers (maximum 1 ha.of land) constitute 80 percent of farm households, containing 10 percent of absolute landless (having neither land and nor homestead areas). Their number increased to 9.42 million in 1996 from 7.07 million in 1883/84. These small farm families are the driving force and main contributor of Bangladesh agriculture. It is shown in the **table no.** 1 that these policy changes and support of the Government can not stop the further marginalization of the small holdings putting them in more vulnerable situations in terms poverty and income. Elimination of subsidies deprived poor farmers to get some indirect and seasonal support. Emergence of non-farm rural incomes and pre-commercial farming as new strategy to face food security problems were noticed during this period.

Cost of Production: The cost of production of rice over three decades has been shown in the **Table no.2**. The cost of production is one of the highest in Bangladesh compared to neighboring countries. Table no. shows how it has been increasing overtime. This affects most poor farmers. The major concern is irrigation cost which is around 52 percent of total cost. Poor farmers have little financial capacity to increase the productivity of farming systems bringing more of their land under irrigation. They also are not able to cultivate land under leasing or mortgage systems due to higher initial costs. On the other hand the out of farming is uncertain due to natural calamities. In view of that they could not take high risk for better yield through input utilization. The open market has failed to reduce the cost of inputs rather put the farming systems under severe competition with foreign agricultural goods.

Diversification : Bangladesh agriculture in general and farming systems in particular was highly diversified during pre-green revolution period. Diversification helped farmers to minimize the risk of farming and produce diversified food for maintaining their nutrition security. Liberalization and open market economy could not bring any major changes in the land use pattern and diversify the farming systems further rather it has been broken down into component and cropping patterns become more rice based oriented. Area under rice and some other crops (mainly vegetables and potato) is on rise at the cost of cash crops. It can be seen from the **table no. 4.** What is markedly noticed is the transformation of rice crop land from one season to other season. More than 70 percent of deep water rice (DWR) has been already transferred to Boro rice and same thing is happening in case of Aus thanks to development of irrigation facilities in those areas. Transformation of DWR and Aus areas under Boro rice has been making significant contribution towards increasing rice production.

Changes in the Cropping Pattern : Transformation of cropping patterns overtime has been shown in the table **no 5.** Trends show that cropping patterns are becoming more rice based. It is happening in the favourable eco-systems. The cropping patterns of un-favourable eco-systems remained almost unchanged again indicating the fact that policy reforms did not touch the farming systems of poor people and vulnerable areas.

Changes in the Farming Systems : Despite the numerous efforts by all successive governments since last more than three decades, graduation of subsistence farming to pre-commercial farming has not been happening and their number is on rise. On the other hand, to sustain their farming systems to ensure their livelihoods they have been exploring several available avenues but without visible success. Intensified homestead cultivation, reducing livestock sector, rice-rice cropping systems are the main components of their farming systems. On the other hand, elements of commercial and pre-commercial farming with limited knowledge could be seen in the farming systems of medium and large farmers. Fish cultivation has been increasing in their farming systems observing reversing the declining trends of 80s **(table no. 6)**.

Productivity Gain : Undeniable fact is that productivity of rice has gone up with significantly year to year variation. It has happened mainly during late 90s and country has achieved self-sufficiency in food production for the first time in 2000 since independence. Unfortunately, it could not be sustained even in the next year. Reasons for productivity gain are: transformation of DWR and Aus season rice area to Boro rice area and input liberalization policy of the Government.
Production increase also observed in case of vegetables and potato. The reason for unable to make the rice production systems sustainable and stable is due to low and un-sustainable productivity of farming systems of poor farmers.

Pre-Commercial and Commercial Farming : In the late 90s, country observed the emergence of pre-commercial and commercial farming in some pocket areas of the country thorough the initiative of private sector. This has been happening mainly in the poultry, dairy and fish sectors and is considered main reason for the increasing production of those commodities at national level in the period of globalization. Component wise agricultural production systems led to emergence of non-farmers group in agricultural business.

Technological Development : Although Bangladesh opens the door for all through process of globalization, infusion of modern and frontier agricultural technologies and their adaptation and adaptation by the farming communities is not at expected level. This is one of the reasons why productivity of different crops is still low and it is applicable also for other sub-sectors of farming systems like livestock and fisheries. Whatever technological benefit country receives so far, due to poor on-farm and adaptive research at farmers' level, these technologies could not adjust with the farming environment of subsistence farming.

Digital Divide : Capacity of medium and large farmers to adopt more modern and frontier technologies compared to poor farmers has been widening the gap between two types of farming systems. Farmers of unfavourable eco-systems could unable to adopt these technologies to their farming environments without external supports and thus there is every possibility to think that the gap will be further widened if this situation continues.

Degradation of Natural Resource Base and Environmental Hazards : Use of Green revolution technology for productivity gain created second generation problems and responsible for emergence and progressive expansion of less favoured environments. Some important issues in this regard are : loss of soil fertility; nutrient imbalance, soil salinity, water logging, genetic erosion, chemical toxicity and floods and droughts. Despite rich endowment of nature, farming systems continues to remain vulnerable to a number of productivity-constraining stresses. The N.P.K ratio was 1.0:.037:0.10 in 1985/86 and 1.0:0.11;0.09 in the 1996/97 against the recommendation of 1.0:0.67:0.33. The trend in the NPK ratio reflects the

continued and growing imbalance in chemical fertilizer use causing the stagnation and declining productivity in some areas of the country and loss soil fertility. The volatile policy environment injects risk and uncertainty affecting most resource poor farmers facilitating more imbalance use of chemical fertilizers.

Lessons Learned

There are already sufficient evidences to believe that economic liberalization and globalization might have little effects in improving the livelihood conditions of the people of un-favourable ecosystems and their farming systems as it was happened during Green revolution period. Input liberalization and open market policy of the Government has been bypassing the poor farmers, unlike Green-revolution, making their farming systems more vulnerable and less competitive. Farming systems of poor farmers are moving towards crop biased production systems from highly diversified farming systems of pre-green revolution period. Food and livelihoods could not be improved keeping these farming systems at subsistence level. Policy reforms could not be able to solve the problems of subsistence farming in terms of its productivity and income. On the other hand it is policy reforms responsible for making their farming systems costly and less productive and further marginalization. Age old land based agricultural production systems has been gradually transferring to capital intensive agriculture where land does not play much role and poor farmers could not effort it at all.

Task Ahead

There is no scope to debate on the globalization issue. It is a reality. However, poor farmers also should get benefit out of it. Poverty situation of the country could not be improved until their subsistence farming systems could be transferred to pre-commercial and commercial farming. Clear evidence of it is the higher number of hard core poor people in the country and their number has been even increasing. Appropriate pro-poor policy, updatation of policy, their proper implementation, continuous monitoring of policy implementation process and good local governance are some of the issue that needs urgent attention so that globalization could touch poor farmers and make win-win situation for all.

Transformation of major Cropping Patterns

Cropping Patterns of 80s	Cropping Patterns of 90s	Remarks
Winter crops- B.Aus –Fallow	Boro-Fallow-T.Aman	Favourable eco-systems
Winter crops- B.Aus- T.Aman	Boro-T.Aman-Fallow	Favourable eco-systems
Fallow-B.Aus-T.Aman	Fallow-T.Aman-Fallow	Un-favourable eco system
Boro-Fallow-T.Aman	Boro-Fallow-T.Aman	Favourable eco-systems
Fallow-Fallow-T.Aman	Fallow-B.Aus/Shirmp-T.Aman	Favourable eco-systems
Winter crops/Fallow- mixed B.Aus& B.Aman	Pulse/Oils- B.Aman+ B.Aus	Un-favouable eco-systems
Fallow - B.Aman - Fallow	Fallow-T.Aman-Fallow	Un-favourable eco system
Boro-Fallow-Fallow	Boro-Fallow-Fallow	Un-favourable eco system

Table no. 1Changes in the Areas over Three Decades (Million Hectare)

Crop	1971-72	1981-82	1991-92	2003-04
Rice	79.87	80.58	74.50	77.53
Wheat	1.10	4.11	4.17	3.99

Maize	0.02	0.01	0.03	0.43
Other Cereals	0.60	0.43	0.66	0.30
Total Cereals	**81.59**	**85.13**	**79.36**	**82.25**
Jute	5.83	4.40	4.28	2.76
Other cash crops	2.13	2.23	2.19	2.16
Total Cash Crops	**7.96**	**6.63**	**6.47**	**4.92**
Pulses	3.09	2.35	5.26	3.15
Oilseeds	2.61	2.26	4.12	2.80
Spices	1.38	1.16	1.05	1.78
Potato	1.21	1.34	1.28	1.98
Vegetables	0.89	1.01	1.26	1.86
Fruits	1.02	1.07	1.10	1.24
Total	**11.618**	**12.977**	**13.749**	**14.223**
Cropping Intensity	**133%**	**143%**	**173%**	**192.5%**

Table no.2. Changes in the Cost of Production

Crop	**1971-72 1 USD= Taka 7.30**	**1981-82 1 USD= Taka 20.07**	**1991-92 1 USD= Taka 38.15**	**2003-04 1 USD= Taka 57.10**
Cost of Production				
Aus rice (Mar- June)	1133.00	2717.00	6728.00	12124.00
Aman rice (July-Oct.)	1075.00	3209.00	7511.00	13027.00
Boro rice (Nov.-Feb.)	1116.00	3978.00	11328.00	22456.00

Table no.3. Policy Changes over Three Decades

Sectors	**Pre-Green Revolution**	**Green Revolution**	**Post-Green Revolution**

Seed	Establishment of East Pakistan Agricultural Development Corporation (EPADC) in 1961 to supply Quality seeds and other inputs to the farmers. Production of seeds through registered growers initiated.	Concept of seed technology was developed in 1976 to supply 5% of quality seeds through public Sectors. Seed Ordinance 1977 Seed rules 1980	Seed Policy was adopted in 1993.
Fertilizer	Establishment of fertilizer industries and motivation of farmers to use fertilizers through crop demonstrations	Initiation of transformation of fertilizer distribution from a public monopoly to a more openly competitive system operated by the private sector.	Significant reversal in the policy reform process. Increasing administrative control in fertilizer distribution
Irrigation	-Introduction of Low Lift Pumps (LLP) and limited number of Deep Tube Wells started since 1961 Through public sector (1961-1979)	-Expansion of LLPs and DTWs continued through BADC and installation of shallow tube wells started in mid-70s. -Expansion of private Sector (1979-84)	-Return to public sector control (1984-87). -Liberalization and expansion of the private sector (1987-)
Farm Mechanization	In 1965, three hundred tractors were imported by EPADC for experimental purposes. In 1970, about 2000 tractors and 4000 power tillers were imported and some of them were distributed to the farmers on credit and some were used in Government farms. Creation of Testing and Standardization Committee	Farm Machinery Policy was liberalized in 1989 waking opportunity to import huge quantity tractors and power tillers	Restriction on power tiller import and standardization requirement removed

Table no. 4.Changes in the Farming Systems

Major Determinants	Pre-Green Revolution period	Green-Revolution Period	Post-Green Revolution Period
Resource Base	Natural Resource	Natural + External Resource	Mostly External Resource

Human Resource	Family	Family+ hired casual labours	Permanent hired labours (role of owners is managerial)
Technology	Indigenous	Locally improved Technologies + Green Revolution technologies	Modern and Frontier Technologies
Management	Family based manage ment (both men and women)	Men dominated management systems	Externalities in management.
Land Availability	Own	Own+ share cropping	Own+ Mortgage+ leasing System
Productivity	Low	Moderate	High
Risk	Low	Moderate	High
Objectives	Food Security	Yield Maximization	Income
Sustainability			

Table no. 5. Major Farming Systems according to Farm Categories

Category of farmers	Before-Globalization	Post-Globalization
Landless-1 (Household having no own land either homestead or cultivated)	Rice production through share-cropping	Rice production through mortgage or leasing of land
Landless-11 (Household with homestead but no cultivated land)	Homestead + rice production through share-cropping	Intensive Homestead + Crop production through mortgage or leasing of land
Landless-111 (Household with Homestead Area and also own land upto 0.20 ha.	Homestead + poultry + Rice production	Intensive Homestead + poultry + crop production
Marginal farmers (Own land upto 0.60 ha with homestead)	Homestead+ poultry + crop+ livestock	Homestead + poultry + Crop
Small Farmers (own land upto one ha with Homestead)	Homestead+ crop+ + Livestock + Fisheries	Homestead+ crop+ poultry + fisheries + high value crops
Medium Farmers (Own land upto two ha.)	Homestead + cereal + poultry + livestock + fisheries + cash crops	Homestead + cereal + poultry + dairy +fsheries + high value crops + agri-business
Large Farmers (Having own land more than two Ha.)	Homestead + Agro-forestry + cereal + poultry + livestock + fisheries + cash crops	Homestead + cereal + poultry + dairy + fisheries +high value crops + agri-business

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An Analysis of Agriculture-Environment Interactions and Policy Options for Sustainable Agriculture In Eastern Al Ghouta (Syria)[1]

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[1] This paper draws on the results of a study conducted with the support of the FAO project GCP/SYR/006/ITA by a team of researchers of the National Agricultural Policy Centre (NAPC), including the author, on Agriculture-Environment Interactions (NAPC, 2001).

Abstract

Agriculture-related environmental issues represent a non trivial share of the broader environmental problems. They are determined by human-induced factors as policy and market failures, institutional failures, and lack of investment. Syria is no exception and the Syrian environment has been suffering from policies that have not effectively considered environmental constraints. The same efforts to manage pressures on environment have been delayed or have been only partially successful.

The research, upon which the first part of this paper is based, consists of a critical assessment of literature review and the analysis of secondary information data, and an empirical survey focusing on a specific research area, the Eastern Al Ghouta district, Rural Damascus Governorate, aiming at understanding the relationships between agriculture and environment, and therefore at analyzing policy options for sustainable agriculture in Syria.

The research shows that the major environmental problems in Eastern Al Ghouta are the resultant of market, policy and institutional failures, such as; (i) a lack of credit facilities, which, if available, could help resource-poor farmers build their assets and improve livelihoods, and (ii) weak extension services and a lack of technical support for technology diffusion and resource-management options, as well as a lack of information on markets. Addressing the policy gaps would minimize the negative effects of natural resource management policy initiatives, and enable policymakers to make informed decisions.

The second part of the paper presents a much more recent picture of the Agriculture-related environmental issues in Syria as a whole which confirms the evidences addressed in the first part. It focuses on the results of the Syrian Farming System Study (Wattenbach, 2004), which provides a framework of analysis based on the consideration of both geographical differentiation and socio-economic stratification of the agricultural sector of Syria, and considers the potential impacts of changes in agricultural policy (e.g. prices, institutional support) at the household as well as aggregate level. Within this framework, the study is the first broad implementation of a farming systems study in a selected number of systems of the country.

Introduction

The Syrian soil is affected by three main types of degradation namely water, wind and Chemical pollution. It is estimated that 17% of the country is affected by some form of degradation and that up to 12 tons/ha/year of soil are eroded in Al Badia alone (Jones, 2001).

Syria has limited water resources compared to the needs of the country. The volume of water from all sources averages 67 billion m3/year. Rainfall, the main water source, accounts for more than two thirds (46 billion m3/year), rivers contribute about one fifth, while springs and underground water account for less than one tenth. The above figures hide the increasing water shortage Syria has been experiencing as result of the continuously increasing demand and of frequent droughts. Indeed, only 9% of the annual rainfall flows as surface water, the major part either evaporating or descending in aquifers. Much of Syria's rangeland has been damaged by attempts to cultivate barley in areas where the mean annual rainfall is less than 200 mm. Now, these areas have a low vegetation cover of annual weeds, which leaves the land exposed to erosion (ICARDA, 2003). Syria now prohibits cultivation within zones where rainfall is less than 200 mm, but the damaged rangelands need to be rehabilitated.

Agriculture is by far the sector that demands the largest share of water at national as well as basin level. Artificial and natural forests cover about 3.2% of Syria. In recent years, the area

under forests grew by 1.8% annually, expanding from 537 thousand hectares in 1998 to 590 thousand hectares in 2003 (MAAR, 2004). This expansion is due to the increased efforts in land reclamation and tree planting. In 2001, 2002 and 2003, about 23, 21, and 17 thousand hectares were planted respectively.

Agriculture-related environmental degradation imposes huge economic cost on Syria. For example, the total cost of overall environmental degradation was valued around SP 29-32 billion in 1997 (US $ 690-890 million) (WB/UNDP, 1998). And the combined costs of soil degradation are estimated to be around US $ 319 million/year, with salinity having the greatest cost per hectare and the greatest overall cost (Jones, 2001). These estimates make soil degradation the most costly of the environmental problems considered (Table 1.1).

Table 1.1 estimated costs of land degradation in Syria in 1997.

Type of problem	*Area affected (000 hectares)*	*Cost/ha/year (SP)*	*Total cost/year (SP million)*
Water erosion-coastal area	1058	2675	2830
Wind erosion-steppe	1620	1370	2219
Salinity	90	105390	9485
Total			14534 (US $ 319)

Source: WB/UNDP, 1998.

Syria is no exception in presenting areas of conflicts between human activities and the preservation of natural resources and cultural heritage. This applies also to agriculture, and it is mainly due to the fact that Syria is heavily resource-constrained in terms of land and fresh water availability. Many are the candidate determinants at the base of the constraint: huge population growth rates, unsustainable and inefficient practices and technologies, lack of information, pervasive market, institutional and policy failures.

In this regard, the research aims at better understanding of the relationships between agriculture and environment, and therefore at analysing policy options for sustainable agriculture in Syria. Specific objectives of the research are:

- identify the structure of incentives that lead farmers to adopt unsustainable agricultural practices;
- advance some policy options for ensuring sustainable agriculture and preventing the misuse of land and water resources.

The research consists of two main parts: (a) a critical assessment of existing studies and data, and (b) an empirical research based on a survey conducted in the surroundings of Damascus,

the Eastern Al Ghouta district, an area of more than 9 thousands hectares, very fertile, but also extremely at risk because of the overexploitation of natural resources. Finally, it provides a summary of recommendations and policy options stemming out from the study.

1 Research methodology

Pursuing the above mentioned objectives requires the adoption of a feasible and realistic approach, based on the following principles: a) the need for an economic-institutional analysis: in a context like the one of Syria, characterized by heavy interventions/regulations by the public bodies, it is required not only the use of economic categories, but also an analysis of the economic content of the institutional set-up which largely affects both the behaviour of economic agents and the outcomes of their courses of action; b) the adoption of the farmer viewpoint: in the perspective of a progressive liberalisation of the Syrian economy, a new and more important role will be played by farmers as crucial economic agents who react to the overall incentives in pursuing their own objectives: those are the key factors who can determine the success/failure of the future agricultural strategy.

The empirical part of the research is based on a field research in the surroundings of Damascus (Eastern Al Ghouta, Rural Damascus governorates), using a semi-structured questionnaire to interview the farmers. Time and budgetary constraints have indeed led to restrict the empirical part of the research in a relatively small area. However, the choice of Eastern Al Ghouta area is very relevant in terms of agricultural production and highly representative of some important environmental problems in the national context (e.g., water depletion, urbanisation, etc.). For example, the prevailing farming system in Eastern Al Ghouta is irrigated agriculture, characterized by fruit trees farming oriented to stone fruit production (mainly nuts and apricot) for both domestic and foreign markets, winter and summer crops aimed at producing fresh vegetables for Damascus market. Both represent productions that are quite common in Syria. Moreover, the agricultural techniques adopted in the area represent the usual mix of tradition and modernisation we can find in other Syrian contexts. The field survey was carried out in spring 2001 and 86 questionnaires were filled in according to the sampling design.

2 Main results

The survey results show that farmers in Eastern Al Ghouta are aware of some of the environmental problems (water depletion and land degradation) and their causes (river diversion, urbanisation, drought, and over-pumping) confirming the information provided by earlier researches. However, they are not aware of other indirect problems such as soil and water pollution, and this strongly contrasts with previous studies results.

The major environmental degradation phenomenon in farmer's opinion is insufficient water for irrigation; 81% out of the total interviewed farmers (86 farmers) (Table 3.1). Then, urbanization comes in the second place (65%), while, quite surprisingly, soil pollution is not felt as a major problem: only 3% farmers is concerned about soil pollution.

Table 3.1 The farmer's opinions about environmental degradation in Eastern Al Ghouta.

Type of degradation	% on total
Water depletion	81
Urbanization	65
Water pollution	5
Soil pollution	3
Total no. of Respondents	100

Source: Survey results, 2001.

Farmers do not perceive water quality change as a severe environmental problem: only 12 out of 86 farmers (3% of the total) notice a change in the water quality during the last ten years and, among the farmers who notice it, only 5% mention water pollution. Researches report such a change in the quality of both surface and underground water representing fundamental hazards for environmental and health issues. More specifically, the situation in Eastern Al Ghouta was assessed by earlier researches on the basis of different types of pollutants (chemical, heavy metals, microbiological, and pesticides) as well as pollution recipients (water surface as well as underground, soil, and agricultural products) (ACSAD/MAAR/BGR, 2000). Surface water, i.e. Barada River and the irrigation channels that depart from it, seem to suffer mainly from organic matter pollution, as proven by the levels of concentration of ammonia and by the level of both Biological Oxygen Demand (BOD) and, to a lesser extent, Chemical Oxygen Demand (COD) which indicates the degree of contamination of wastewater by organic compounds. On the other side, the concentrations of heavy metals - mainly Cd, Cr, and Hg from factories located in the area – are within the acceptance level. Microbiological and biological pollutants, though significantly present, are relatively less important as sources of surface water pollution[2]. Pesticides do not seem to be a great problem in the area.

3 Water depletion

Most farmers (91% of all interviewed farmers) notice a change in the depth of water table during the last 10-20 years, estimating the average change as much as 25 cm/year of water table deepening. The farmers think that the change is due to the severe drought of last years (48% of all answers), to the Barada River diversion (29%) and to well water over-pumping (23%). Huge dependency on wells and underground water depletion are interlinked: water shortage forces farmers to dig their own well in order to ensure a water source to their farms and, on the other side, the extraction rate from the aquifer causes the lowering of the water

[2] The threshold of acceptability for those pollutants when water is used for irrigation is not mentioned, but the threshold level is (0) for drinkable water.

table and eventually over-pumping and higher water shortages. Furthermore, the absence of an ineffective monitoring system (both for digging and operating wells), allows the farmer to behave freely, at zero operating cost and without any cost for the negative externality imposed on third parties, which coupled with water shortages is indeed one of the main determinant of water table lowering in Eastern Al Ghouta.

As a consequence of water insecurity, profit-oriented behaviour and lack of effective monitoring, the total number of wells in Eastern Al Ghouta increased dramatically in the last years. It is estimated at about 2100 wells in the area, which means a well density of 2.27 wells/ha. This is witnessed by the answers to the questionnaire. For instance, almost three-quarters of the interviewed farmers own at least a well/farmer, 80% of them are not registered.

The agricultural technology adopted by Eastern Al Ghouta farmers is considered traditional, especially with respect to irrigation, since water reaches the plot through permeable channels causing huge water loss because of leakage as well as evaporation. It is worth mentioning that 16% of the interviewed farmers report that they do not apply modern irrigation techniques (sprinkling and dripping) because of the lack of knowledge of procedures to be applied, and 16% do the same due to the high cost and the lack of required credit.

4 Urbanization

Urbanization is a huge problem in the research area due to the growth of local population, and subsequent increased demand for housing, and the lack of effective means to regulate illegal settlements on agricultural land.

The population of Eastern Al Ghouta between 1981 and 1994 more than doubled and increased from 123,434 to 247,354 and afterwards, kept increasing. According to the interviewed farmers' answers, the major causes of such population growth are immigration (46% of total respondents), low land price (44%) relative to Damascus city land price, and presence of refugees (5%).

Significantly, nobody reports land-owner behaviour (i.e., building a family member house) as one of the causes of the loss of agricultural land, while the research shows that about 90% of people who build houses on agricultural land are farmers and urban settlers. As a matter of fact, all respondents do not comply with constructing procedures or rules. The phenomenon can be explained by the very high population growth rate driven by high fertility rates and high rate of immigration to Eastern Al Ghouta (due to its closeness to Damascus city), and by the ineffective monitoring system. Again, the problem of urbanisation is determined by individual profit-maximising behaviour and institutional failures. Inheritance splitting, land is allocated to many heirs and therefore the average land size shrinks, and other holdings are split because of the use of land for building purposes instead of investing in agriculture.

5 Conclusions and policy options

The major environmental problems in Eastern Al Ghouta are the resultant of market, policy and institutional failures. Therefore, they cannot be solved with just one simple policy measure. They require a complex of coordinated interventions.

The research demonstrates that knowledge is an integral part of the culture and history of local communities. Therefore, it is the most reliable starting point for the successful socioeconomic development of poor local communities, especially when successfully blended with modern technologies. So, farmers should be trained and fostered to adopt new and more efficient irrigation technologies (like dripping irrigation) and they should be provided with feasible alternative sources of water for irrigation (i.e., network irrigation).

Appropriate institutional setting leads the polluters to pay the cost for their externalities and compensate the damage for water and soil pollution, and fostering the use of appropriate technological equipment would reduce the pollution caused by the factories located in the area. Most important is to set effective monitoring systems to control digging and operating wells as well as to control building of new houses in the agricultural land.

In other words, plans for integrated land and water resource development should take into consideration all necessary technical, agricultural, socioeconomic and institutional aspects and inputs, and should include the training of farmers.

5. Recent development of the issue

Recent policy changes in Syria aim to encourage more efficient, equitable, and sustainable resource use. To investigate farmer's responses to the new policies, as well as the effects on land use and livelihoods, NAPC conducted a research study on the Syrian Farming Systems[3] between 2002 and 2003. It considers the potential impacts of recent changes in agricultural policy (e.g. prices, institutional support) at the household as well as at aggregate country level. The specific objective of the study is to define relatively homogenous areas of agricultural production, regardless of administrative boundaries, based on appropriate agro-ecologic and socio-economic characteristics. Each farming system is characterized by its natural conditions, market integration and historic influences leading to differentiation and specialization of production within it.

The research comprises observation of secondary data as well as primary ones collected through various field surveys. It identifies six different farming systems and characterizes the prevailing household typologies. The farming systems identified are named as follows: The Coastal Intensive Irrigated Farming System, The Hilly Mountainous Farming System, The North Hills and North Plains, The Farming System of Al-Ghab and the Central Plains, The Farming System of Southern Mountains and Plains, and The Pastoral and Agro-Pastoral Farming System (Wattenbach, 2004).

Policy changes and technological innovations affect each household typology differently, depending on the relative importance of the different income sources and livelihood strategies of the household. The characterization of each farming system in the national context allows reviewing the possible aggregated effect of policy change as well as the dependence of a farming system on major crops, which could be subject to policy adjustments.

[3] The author here refers to the draft report of the Syrian Farming Systems Study (Wattenbach, 2004). The research was conducted by a team of the NAPC researchers, including the author, with the support of the FAO project GCP/SYR/006/ITA.

Various environmental concerns emerge from the study. Clearly, each farming system is characterized by its own typical environmental issues. Eastern Al Ghouta is located at the border between the Farming System of Southern Mountains and Plains and The Pastoral and Agro-Pastoral Farming System (Al Badia). Noticeably, the information resulting from the surveys conducted by the Farming System Study relative to the Eastern Al Ghouta area confirm the results of the earlier research. The Efforts for upgrading traditional to modern irrigations have been more successful in the area; however, the enforcement is still an issue.

Governing policies on the registration of land and the transfer of registered ownership of agrarian reform land require urgent attention. The transition from original reform beneficiaries to the next generation has started. It will rapidly broaden the negative effects faced by holders without land ownership title. To the practical difficulties to obtain credit, part of the farmers informally sought pragmatic solutions, which occasionally involve illegal land sales and distribution of land among several young families. This approach is relatively inefficient and carries with it the risk that particularly smallholders negotiate from a weak position in these circumstances and are consequently forced to accept expensive credit arrangements. In some farming systems, holding size is too small to be viable and the social implications of holdings that cannot be sold should be considered.

One of the most important concerns for increasing the flexibility of farm management across Syria is the access to seasonal as well as longer-term credit policies. Particularly, where farming systems have been affected by the recent drought and assets have been lost, mechanisms need to be established to give these farmers new access to crop finance. Marginal producers otherwise face serious difficulties to avoid expensive alternative credit sources. The procedures for guaranteeing credits within the co-operative system include an element of decentralized social control for debt repayment, but are not fully functional at present.
Furthermore, land-tenure issues in many areas of Syria like Al Badia do not encourage development. Farmers are not willing to invest in land that they do not own, or do not have the right to use it for a long period of time. Government policies are often not conducive to the development of such practices.

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Participation in agri-environmental policy development and decision-making in Germany - Status quo and future potentials

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Abstract

The paper analyses a participatory approach in agri-environmental policy development and decision-making on the state level in Germany. The approach comprises an interactive PC-based model and the facilitation of the corresponding communication process. Research objectives are improved communication processes and an enhanced quality of political decision-making. The investigation is based on the assumption that the success of agri-environmental programmes depends largely on their acceptance by all major stakeholders. This implies an early integration of varying interests in the decision-making process. Introducing participatory approaches into a bureaucratic setting poses particular problems. In order to achieve greater efficiency and effectiveness, the introduction of interactive modelling approaches has to be coupled with communication processes which increase transparency and allow for consensual decision-making.

Introduction

The research project "Communication processes in agri-environmental policy development and decision-making" is part of a DFG (German Research Foundation) funded programme "Structural change and transition in agriculture". This programme is based at the Faculty of Agriculture and Horticulture (Humboldt University Berlin), but also includes scientists from the Centre for Agricultural Landscape and Land Use Research (ZALF in Müncheberg) and Federal Agriculture Research Centre (FAL in Braunschweig). This paper introduces research objectives and methodology of the project mentioned above (project 7 of the DFG-programme) and discusses the results obtained so far.

The author collaborates closely with a second research team (project 6 of the DFG-programme) who is developing and testing a mathematical programming approach for structuring complex priority setting and decision-making processes (Kirschke et al., 2004b). Overall objective of the combined research effort is enhancing the quality of political decision-making through an interactive approach using formal and informal instruments as well as combining quantitative and qualitative elements. The case study is based on a test run of the PC-model as well as on a stakeholder and problem analysis. The experimental part of the case study comprised meetings and facilitated workshops at the *Ministerium für Landwirtschaft und Umwelt* of Sachsen-Anhalt state (Ministry of Agriculture and the Environment). Project 7 has a distinct social science background and focuses on the communication process (facilitation, stakeholder and problem analyses) while the mathematical programming approach is handled by project 6. Due to the role of the model within the participatory approach it will be mentioned but it is not at the core of the investigation.

The amount of public funds spent on agri-environmental programmes has slowly but steadily increased over the past two decades. These programmes support environmentally friendly farming practices and are part of the second pillar of EU agricultural policy. Each reform places more emphasis on the "greening" of this policy. It is of interest that these agri-environmental funds should be used effectively, i.e., the specific programmes must contribute to the objectives they are originally set up for. To ensure a programme's effectiveness, it is not sufficient to only involve expert administrative staff and experts from research institutions but also those actors towards which these programmes are targeted. One reason fo this is that both, expert communities and political actors will only have limited information about the potential impacts of a programme and about factors influencing the decision of a farmer to apply or not for a programme.

The uptake of a programme is a prerequisite to achieve any effects at all due to the voluntary nature of the schemes. A high rate of uptake is also the goal of policy makers: they want to develop schemes that actually deliver the money to farmers and land managers. To receive financial aid, farmers have to comply with certain regulations and implement specified measures. In order to measure and evaluate the impact of schemes a static analysis of the status quo will not be sufficient. There has to be a permanent interchange between societal objectives, transformed into the objectives and measures of a funding programme, and the impacts acknowledged by clients of the programme and scientific experts. Only with institutionalised feedback mechanisms it can be ensured that the effects of a programme take in fact the direction intended. However, there are no such mechanisms in place at present.
The research concerns participation[4] and feedback processes as well as co-operation and decision-making. It is intended to support and optimise these communication processes. "Optimal" is defined as the gathering of necessary information from relevant actors with a minimal effort as well as the smooth integration of information into decision-making by administrative bodies. The aim of the research is to develop a methodology which helps to increase acceptance and legitimacy of agri-environmental programmes. At the same time, efficiency and effectiveness of communication processes in complex political systems are to be improved.

The main focus of this paper is to introduce an innovative approach to participation in political decision-making. I will describe the concept behind the approach, propose a participation strategy for the specific context of policy making at the state level, present the results of a case study in Sachsen-Anhalt, and discuss the applicability and limitations of such a strategy.

Problem background

The development and implementation process of an agri-environmental programme will consist of a planning phase, i.e., the agri-environmental policy development, and an implementation phase including the farmers application for funding and the realisations of certain measures and /or compliance with certain regulations. The development phase which this paper focuses on is subject to a number of potentially conflicting demands of government, administrative and political actors, nature conservation and environmental protection organisations and, last but not least, farmers. Renn et al. (1993,189) predict that

[4] In this paper, the term 'participation' refers to the involvement of different stakeholders in decision-making processes. This differs from the common use of the term describing farmers' uptake of agri-environmental schemes or entering agreements.

"there is no ideal solution to the conflict among the legitimate demand for public participation, the need for technical and economic rationality, and the necessity for assuring accountability and responsibility of decision making bodies."

In Germany, the general procedure of agri-environmental policy making is similar for all federal states (*Länder*). It is the state ministries where decisions about the use of subsidies are made. The respective ministries for agriculture are responsible for development and coordination of a programme. The general objectives for an agri-environmental funding scheme are set on EU-level and federal level. A state has the task to operationalise/ concretise these objectives and transform them into a funding programme. Usually, these programmes comprise several measures or prescriptions.

There are no hard and fast rules as to who is to be involved during this phase. One group of actors are administrative bodies like neighbouring departments within the ministry, advisory bodies or agriculture agencies (*Ämter für Landwirtschaft, Landwirtschaftskammern*). Another set of actors are interest groups. Their involvement is largely informal and non-regulated. In general, German politics are characterised by strong involvement of the major interest groups in policy-making, in particular in the area of policies dealing with agriculture (Wessels, 2000). This has sometimes been called corporatist participation, in contrast to public participation. Although the relevant EU legislation (EU regulation 1257/99 and its successors) demands the involvement of groups whose interests are affected, the final selection of who can participate depends on the (actual or anticipated) influence of the association, personal characteristics of the group's representative and the decision of senior staff in the ministry. The *Gemeinsame Geschäftsordnung* (management and public relation rules) of the ministries usually only define in broad terms that "relevant stakeholder groups shall be involved". The term comprises major interest groups and top organisations of relevant unions and associations, local interest groups and other parties with the legal right to participate (Ministerium des Inneren Land Sachsen Anhalt, 1998). In some cases, experts are consulted by the administrative authority and influence the process during this phase. The draft of the programme is then presented to other relevant authorities. The above mentioned organisations can now formally comment on the draft. The EU commission will check whether the draft proposal meets the existing requirements. If so, the programme is agreed upon and the implementation phase begins. A significant number of decisions in the process of programming has to be made under an enormous pressure to meet deadlines.

The individual farmer or other citizens are not involved at this point. Information is fed into the process exclusively through the informal participation of interest groups and associations. The only way farmers can express their opinion on the programme is to apply or not apply for the funding scheme. When applying, farmers may comment or complain, usually to the agriculture agencies. However, this is too late for any adjustments to the programme. One can state that regardless of the type or degree of informality, any existing means to gather information and feed it back into the decision-making process in agri-environmental policy development are not institutionalised.

Agri-environmental programmes may be developed nationally or at state level but they are always implemented locally and must be locally understood if the promise of multifunctional agricultural landscapes is to be achieved (Bills and Gross, 2004). Aarts and Woerkum (1995) emphasise the importance of communication for the acceptance of governmental policies. If the acceptance of programmes by farmers is a political objective, contents and

implementation of agri-environmental programmes must meet the preferences and needs of clients and users. Consequently, these preferences and needs must not only be known to policy makers but they must be channelled into the programme development process. Thus, a permanent flow of information as well as practical communication support instruments are needed. This interdependency of organisational change and participatory planning and decision-making was aptly illustrated by White (2001). The aim of improving organisational structures will thus entail the institutionalisation of feedback mechanisms and the development of interactive forms of participation.

Research Questions and Objective

The research objective is to develop a methodology[5] which helps to increase acceptance and legitimacy of decisions about agri-environmental programmes. At the same time, efficiency and effectiveness of communication processes in complex political systems are to be improved.
Research questions are:

- Which goals and values of stakeholders have an impact on the decision-making process? How are they formed and expressed? Which information is channelled into the process, which is not? Which institutional arrangements and interest groups are significant?
- What specific set up of the decision-making process is necessary to achieve a high level of acceptance and reduce potential conflicts? Which conflicts have surfaced in the past and what institutional experiences have been made with their resolution?
- How should communication processes be organised to meet the requirements of the programming approach? What are feasible ways to ensure transparency of the decision-making process? How do we integrate an optimal set of information from relevant stakeholders and programme users to improve decision quality? Who must be involved in a particular process and in what way? Does the compilation and return of feedback contribute to the quality of the decision?
- Which changes in the organisations would result from such a participation strategy? What impact do those changes have on the improvement of decision quality?
- To what extent is the methodology developed transferable? What are necessary preconditions? What are chances for creating these preconditions?

[5] This "methodology" is not to be confused with the methodological approach applied throughout the research project. However, the methodology to be developed may contain some elements of the methods mentioned for level (1), such as pre-planning of meetings or facilitated workshops.

Our preliminary hypothesis is that comprehensive involvement in decision-making processes will lead to the integration of more relevant information and thus have a positive impact on the output. The provision of transparency at all times will enable all actors involved to reconstruct the results as well as their pathways. An increase in quality results - as judged by the different stakeholders - will raise acceptance of programmes and therefore enhance the impact of the decision taken. However, limits of and to participation and transparency will also have to be analysed.

Methodology

This study is a piece of action research. Action research refers to the conjunctions of three elements: research, action and participation. According to Greenwood and Levin (1998, 6) it is "...a form of research that generates knowledge claims for the express purpose of taking action to promote social change and social analysis." In action research, the professional researcher and members of an organisation seeking to improve their situation are seen as members of a team, both equally participating in the research process. This type of research aims to develop problem-oriented and context-adapted solutions based on the cooperation between research and "real life".
Methods are used on two different levels:

(1) Methods to *guide* the communication process itself which may include "action methods" like the pre-planning of meetings, consultancy to staff members or facilitating workshops. In supporting co-operative decision-making, special attention is paid to ensure openness, objectivity, transparency of the process, constructiveness and mutual support. These methods have been employed during the experimental part of the case study, i.e. the organisation of the workshops.
(2) Methods to *analyse* these processes will serve to document and evaluate the process of co-operative decision-making on a scientific basis. Methods employed are those of qualitative, empirical social research and include techniques like face-to-face interviews, participatory observation, and document analysis.

Concept and structure of the participation approach

Renn et al. (1993, 210) "are convinced, that rationality is enhanced through participation while participation is facilitated through well-structured procedures." A large number of different participation approaches and instruments have been developed, some combined and some tested (e.g. Dienel, 1971; Renn, 1993; Feindt, 1996; Korf, 2003). Reviewing the literature in this field one notes restrictions which apply to most methods. These restrictions concern the people who should be involved, the situation in which participation is organised and the purpose of participation. In addition, the social and political framework plays an important role, i.e., the country and the level in which participation takes place. As the participation strategy presented here is developed and tested in the context of German administrative structures the focus is on publications dealing with this particular context.

Bogumil (2001) and Zilleßen and Barbian (1992) are some of the authors that note a trend towards citizen participation at the local level. Utilising citizens' opinions as a valuable source of information for any decision-making process seems to be a widely accepted notion. However, despite the increasing opportunities for citizens to influence decision-making processes, this has not resulted in greater public satisfaction with decisions taken (Illsley,

2002). This apparent contradiction illustrates the fact that participation is not an end in itself. Tyler (2001), Hillier (1999), and Knierim (2001) identified a number of constituent elements for the success of participation processes. One important factor is the perception of the process as a fair one by the actors involved. Though different in scale (local sewage treatment plant to international airport), local level experiences with participation processes dominate, with local governments initiating and/ or carrying out the process. There is much less evidence of citizens' participation at a higher level, e.g., the *Länder* level. Indeed, we know of only one case in Germany where individual stakeholders took part in agri-environmental programming processes (Freese, 2004).

When developing a participation strategy for the state level administration concerning policy development, some particularities and problems inherent in bureaucratic organisations must be taken into consideration: The poor flow and distribution of information is an omnipresent problem of administrative organisations. Differences in perception and the filtering of information as well as the hierarchical and sector-oriented structure of organisations may pose serious communication barriers. Walters (2000) identified a number of problems that can occur when organisations communicate, one of them being self-referentiality, i.e., the tendency of organisations to see the world as they see themselves. The formal act of communication is supplemented by informal communicative behaviour, the latter enjoying a growing significance and acceptance. Objective and subjective factors concerning the role and position of administrative players and stakeholders predetermine their space for decision-making, e.g. standards and regulations, individual attitudes, interests, status, or commitment to the respective organisation. And last but not least, decision-making processes are always linked to issues of power.

The project combines within one approach two instruments of quite different nature. This is in line with O'Hara (1999, 83) who attempted to integrate "quantitative modelling techniques and qualitative discourse based valuation methods" in order to form a basis for improving information about operative decision norms and decision criteria in sustainable development. Mathematical models for decision support, such as linear programming, are used for a range of topics from solving environmental problems to budgetary questions. Kirschke et al. (2004b) have developed an interactive PC-based programming approach. The model serves to visualise objectives, funding programmes, restrictions and allows to look at different scenarios, facilitating and structuring the discussion in combination with a participatory approach. The term "interactive" refers to the use of the model. One or more persons can use it in an interactive rather than instrumental way, feeding in information, changing parameters, assessing the calculations and the scenarios. Within the present research, interactive actors include all stakeholders involved in the development and implementation of agri-environmental programmes. Facilitating the involvement of all actors, making use of their knowledge and managing the discussion of the available options are major contributions from the complementary qualitative approach.

The mathematical model links agri-environmental measures via the contribution each of the measures makes to a respective objective. The "contributions" (= coefficients) are an important interactive link. As long as there are no objectively verifiable means to quantify these coefficients, various data sources may be used as a substitute. Thus, participating actors will be asked to rank, and questionnaire surveys can be used to gather additional valuation

data from actors not directly involved in the discussion process[6]. In addition, restrictions applying to all or individual measures are taken into account. Based on these links, the mathematical model will calculate the optimal distribution of funds on the basis of the data utilised. This process will include the following steps:

- Preparation phase (in co-ordination with the initiating authority);
- Introduction of model to participants;
- Facilitated discussion of objectives, restrictions;
- Inquiry of coefficients (participants rating programme contributions);
- Setting of a reference situation and discussing of scenarios.

The proposed participation strategy is based on three working hypotheses:

1. Comprehensive and serious involvement in decision-making processes will lead to the integration of more relevant information and thus have a positive impact on the output.
2. The public acceptance of agri-environmental programmes is increased through participation of stakeholders and integration of feedback.
3. The mathematical model improves communication and decision-making processes. It makes information and decision-making processes transparent and more efficient, visualise assumptions as well as their impact on results.

Success of the proposed strategy depends on a number of preconditions. We assume, first, the serious desire for improving decision-making and implementation of agri-environmental programmes and, secondly, an openness towards stakeholder participation as one means to reach these objectives. In addition, a minimum of transparency to carry out a project is needed both, on the side of clients and officials within administrative units. Müller et al. (2002) identified some additional preconditions for successful co-operation: The individual perception of the urgency of an issue and the obvious benefit for the people concerned.

Results of the case study in Sachsen-Anhalt

The case study describes the first application of our approach. The test run was undertaken in collaboration with the Ministry of Agriculture and the Environment of Sachsen-Anhalt state (*Ministerium für Landwirtschaft und Umwelt*, MLU) in June and July 2003. First contacts were made through the deputy minister, the actual research co-operation is with Department 5: "Agricultural policy and promotion (*Agrarpolitik und Förderung*)". Involved in the project are the head of the department, the head of one division as well as some staff members. Department 5 has regular but largely informal contacts to farmers' associations whose representatives are invited to discuss adjustments or co-ordination issues. Direct contacts between individual stakeholders and the MLU are rare and most communication is channelled via the representatives. A detailed description of the test project is given in Prager (2004). The mathematical programming approach as developed by the sister project and used in the workshop is documented in Kirschke et al. (2004a and 2005). This publication also provides information on calculations and scenarios.

The first run of the module was specific in the sense that due to unavoidable framework conditions – the final decision had to be reached within a short time period – a number of preparatory steps were undertaken exclusively by the researchers which otherwise would have been part of the participatory process. Data was collected, processed and presented to

[6] The latter option has not been applied yet.

the participants concerning the predetermined set of nine government programmes.[7] The choice included:

- Compliance with extensive pasture management (branch of farm)
- Compliance with extensive pasture / grassland management (sheep)
- Compliance with extensive pasture management (cattle)
- organic farming
- environmentally friendly cultivation of vegetables, spice and medical plants, fruit, vine, hop
- Conservation agreements covering:
  - Extensive grassland management (hay cutting, grazing)
  - Management of traditional orchards
  - Management of arable fields in order to protect species like common hamster, Grande Outarde *Otis tarda*, conservation of arable weeds, arable field margins
  - Upkeep of abandoned land incl. abandoned grassland and abandoned orchards.

The group of participants discussed the potential objectives of agri-environmental programmes. They agreed on two overriding objectives: "Improvement of environmental quality" and "Securing levels of employment in the agricultural sector". Detailed stakeholder and problem analyses were not conducted until after the two workshops, due to the circumstances mentioned above. Exploratory data for these analyses were collected by attending meetings within the ministry (method of participatory observation) and by interviewing staff of the ministry and representatives of the respective stakeholder associations. Based on these interviews the chances for involvement of farmers themselves were assessed.

The research design allows for repeated interviews, visits and observation. Similar to a puzzle, the pieces of information gathered over time will be joined together and – using feedback – will be validated. The use of different methods – triangulation of methods – decreases the chance of possible mistakes and improves the validity of research results.

Discussion and Conclusion

The participatory approach (mathematical model plus facilitation of the communication process) was developed to provide support for complex decision-making at the state level. The stakeholder analysis showed that both, governmental and non-governmental actors participated willingly in the project to discuss budgetary priority setting with the support of a PC-based model. There was a particular interest on the part of the ministry as shown by the fact that the concerned department head acted as convenor and chairman of the workshops. The level of interest was due to a number of factors, some objective, others subjective: The head was familiar with the type of thinking behind the module and immediately saw the potential for increasing administrative efficiency. There was an enormous time pressure to decide on the state's future agri-environmental programmes. The deputy minister opened the second workshop, thus demonstrating the importance the ministry attributed to the project.

[7] Data source was the ministry and there was no chance for re-check. In practice, this did not pose a problem as all actors involved accepted its validity.

The ministry staff involved were content with the outcome of the two workshops. Although non-governmental actors were at first also satisfied with the outcome of the workshops they repeatedly criticised the way the ministry consequently dealt with the results. In their view, officials failed to integrate the consensus into a paper containing suggestions for revising funding programmes which was presented at a meeting about four weeks later. This led to disappointment and a loss of interest on the side of the involved stakeholders. Nevertheless, both governmental and non-governmental representatives expressed their willingness to continue the project at a given time.

The authors realise the importance of a final step in the application of the model: the transfer of results into actual policy making. However, this is a task beyond the scope of the research team. The role of the research team is to provide a service, i.e., facilitating the strategic discussion about the adjustment of agri-environmental programmes in the federal state. The researcher does not propose own positions and opinions but aims at supporting the communication and decision-making process of the actors themselves. The stakeholders may also suggest further steps. All this is seen as part of the action research process. This process is analysed using the methods of qualitative, empirical social research. Thus, the research team is autonomous in their research as far as survey and analysis are concerned, but it relies on the administrative staff for co-operation and in their choice of the case study as well as implementation steps. This is in line with the basic assumption that participatory approaches cannot substitute but supplement administrative decision-making processes.

The instrumental side of the approach did not pose a problem. Workshop participants reported that the mathematical model was well explained and they gained an understanding within a short time. Concerning the facilitation and structuring of the accompanying communication processes, two factors stand out as decisive. Achieving consensus, guaranteeing transparency, and keeping everyone in the boat are highly dependent on the *trust* of all stakeholders in a fair process. Secondly, this trust can not be taken for granted and has to be established step by step – a fact which emphasises the importance of the *time* factor. White (2001) highlights the importance of trust as a key element of the inquiry into participation and organisational change. Both aspects have to be taken into account by the research design. However, personal idiosyncrasies of particular actors and the communication experiences of stakeholders in the past also play and important role. The design must, therefore, allow for flexibility and adaptation.

Most of the difficulties encountered are related to the preconditions defined earlier. As the model has no immediate problem solving capabilities its benefit may not be immediately obvious to the participants. The openness towards using this new approach correlates directly to the individual or collective perception of urgency. This was the case during the first round but in the following other issues where placed at the top of the agenda. Thus, there has been no follow up and the approach has not been used to realise its full potential, i.e., political strategy development. One can safely assume that in private business, the approach would encounter less problems. Management there is used to thinking in terms of planning by objectives, effectiveness and efficiency. Administrative staff may be less inclined to thinking in these terms. Here, rather diffuse visions and goals tend to dominate and the definition of measurable normative objectives is quite uncommon. The model provides for transparency and displays a clear structure of determinants in a decision-making situation. Indeed, transparency is not always welcome since it is feared to lead to the loss of competences and power or disclose too much undesired information.

One assumption was the openness towards stakeholder participation. Governmental staff have little experience with participation apart from the rather formal interest group hearings. This type of involvement of interest groups, such as farmers, is seen as adequate representation. As Korf (2003) put it: "Citizen participation is difficult to institutionalise and the bureaucracy often finds it challenging and tiresome to co-operate with "unorganised" citizen groups without formal institutional structures and hierarchies." Citizen involvement is assumed to be a costly and time-consuming process with no valuable outcome. Staff at the ministry is usually not trained in the facilitation of communication processes, a fact which has negative impacts on the quality (e.g. efficiency) of the meetings. Still, it is unlikely that a professional facilitator is employed to structure and visualise a discussion. In contrast to other processes within a ministry which are regulated in detail and where every employee knows exactly what to do in a given situation there are no such guidelines for participation. Furthermore, the participation process is difficult to integrate into administrative routines. Staff are not used to the application of mathematical models for strategic discussions, but this may be the problem most easily to overcome.

The sectoral administrative structure exacerbates the involvement of nature conservation and environmental organisations. Virtually all communication between environmental NGOs and the ministry is dealt by another department. The split of responsibilities (departments dealing with separate sets of stakeholders) entails communication interior conflicts between departments, between departments and interest groups and to a lesser extent even amongst interest groups. While the horizontal communication within a division of the ministry follows established bureaucratic patterns and the staff meet on a regular basis, communication with other divisions is less regular and not institutionalised in the same way.

Regarding communication channels between the ministry and the representatives of interest groups, both formal as well as informal channels are used. Beside formal hearings there are frequent informal contacts through the phone or at informal ad-hoc meetings. The significance of informal channels seems to be very high. The challenge is to utilise these communication channels in favour of a structured participation strategy to include more relevant information in the decision-making process.

We infer from this study that the approach is suitable to involve farmers and the wider public in the decision-making process on agri-environmental policy development under specific conditions. Firstly, the participation capacities of people in the local communities to become involved in the process need to be considered (see White, 2001). And secondly, it takes behavioural and procedural change within the administration (including open-minded senior staff to adopt and repeated attempts to adapt the strategy for administrative processes. This reasoning corresponds with Aarts and Woerkum (1995, 4) who state "Unless governments are profoundly aware of this tendency towards self-referentiality and willing to change themselves, an interactive approach is bound to fail."

A number of research questions remain to be answered, for instance whether or not the compilation and return of feedback contributes to the quality of decision making and how this quality should be measured. A shortcoming of the research is the question of transferability: the approach could not be tested in different settings. Throughout the project the research team has contacted ministries in four different *Länder*. Only one (Sachsen-Anhalt) was

willing to co-operate initially. However, despite the verbally expressed interest on the side of staff and departmental head, no follow-up could be arranged. An offer to facilitate discussions was declined even though this was to be free of charge, with the department choosing time, goal and participants. This contrasts sharply with the demand formulated by a representative of the agricultural authority in Thüringen who claims that one requirement for the future is "...to intensively further public relations, set up a discussion forum for all whose interests are touched, and maintain and develop a 'participation culture'." (Hochberg 2004, 45). The overall experience confirms the reluctance of administrations to adopt organisational innovations enhancing participatory processes.

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Multifunctionality as a Framework for Farm Policy

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ABSTRACT

The last forty years has seen a significant recent shift in conventional economic development policy paradigms around the world, especially a movement from relying on state-led mechanisms toward compelling a laissez faire concession to market forces. In general, the rapid imposition of market liberalization, reduction of the role of the state, and escalation of what some describe as inequitable international trade rules have left the agricultural sector vulnerable throughout the global economy.

Although a great deal of research exists on agricultural systems and related farm policy, past analysis routinely focused on studying narrow slices of a highly complex issue. More needed is a comprehensive analysis of agricultural policies utilizing a multidisciplinary approach that ensures both food security and ecological sustainability.

Recent articles suggest that some form of multifunctionality may be a basis for sound farm policy in the developing world as well as the advanced economies. Policies based on multifunctionality compensate for goods and services - other than food or fiber - that agriculture produces, even though these often go unrecognized in the marketplace. If potential ecological and social benefits of agriculture are to be realized, new programs must create alternative means of investment into agriculture, ecosystems, and rural communities.

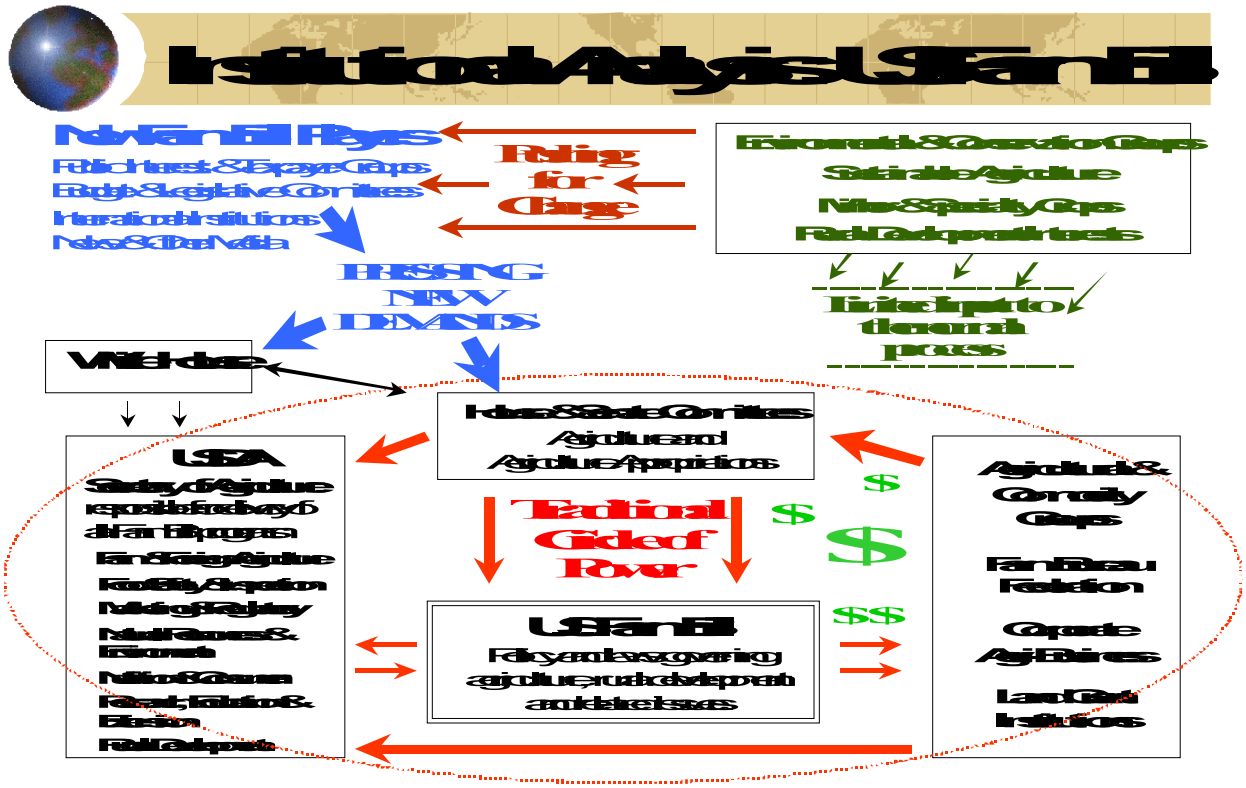
Background

The world is undergoing a major restructuring in how food is produced and distributed; there is a substantial - and growing - distance between those making farm production decisions and the people actually involved in the activity of producing food products. Capital now moves quickly around the world, seeking the greatest immediate return on investment, while large agribusiness firms control most new technology (Ray et al., 2003). Subsidies from the developed world's farm policies are under attack as trade distorting while many developing nations are struggling to adapt to new regimes within the World Trade Organization (WTO) (Lobe, 2004).

Moreover, the past forty years has witnessed a significant shift in conventional economic development policy paradigms: moving from reliance on state-led mechanisms toward recent efforts to compel laissez faire market liberalization (Kydd and Dorward, 2001). In general, the rapid imposition of market liberalization, reduction of the states' role and escalation of what some would describe as inequitable international trade rules, leaves the agricultural sector vulnerable throughout most of the developed and developing nations.

Public support for agricultural policy in the United States (US) relies heavily on the perception that programs are designed to help independent family farmers while maintaining a safe and affordable food supply. Nevertheless, in recent years, there has been an escalating viewpoint that US farm programs have become "welfare" programs for wealthy landowners and large multinational agribusiness corporations (Riedl, 2002). Coupled with such concerns are mounting challenges to biotechnology, industrial-style production methods, and

international trade itself. Many of these same factors are also present in the European Union's (EU) Common agricultural Policy (CAP) and elsewhere. This situation has created an opportunity to re-examine the goals and objectives of farm policy and explore a new policy framework as shown below.



Debate Intensifies on Farm Policy Reform

Current arguments explore the merits of small-scale production versus larger industrialized farms versus forms of 'cooperative' agriculture. Some critics of farm policies urge elimination of all direct payments to farmers, while others support subsidies but would limit access to those meeting specified income limitations. Many environmental groups advocate incentive-based farm programs emphasizing environmental goals while others would strengthen regulatory approaches. While there remains support for government investment in research, extension, technology, and risk management, how much and where is hotly debated.

Many economists have recommended policies that would "decouple" farm subsidies from production decisions; the concept is to provide some level of payments that have minimal impacts on production and are thought to be less trade distorting (IFPRI, 2003). However, with little data or track record, it is difficult to assess the impacts of new "decoupled" programs. On the one hand, decoupled payments could slow farm sector consolidation if the payments allow marginally viable, smaller farms to remain in business longer. In contrast, decoupled payments could accelerate sector consolidation if larger operations use the payments to buy smaller operations or to rent more acreage. This would occur where large operations were previously constrained by lack of access to desired credit or if the lower opportunity cost of using these funds (relative to the costs of commercial loans) were sufficient to motivate expansion (Westcott and Young, 2004).

With Brazil's recent win of a key WTO ruling against U.S. cotton subsidies, it is now doubtful that the new "decoupled" policies are actually going to work. Immunity from legal challenge, given most subsidies by the "peace clause" inserted into the Agreement on Agriculture in 1995, has now expired, removing the legal cover protecting the bulk of the developed world's farm subsidies. Simultaneously negotiators from the US and the EU have pursued global trade talks in the "Doha" round of the WTO while international non-governmental organizations (NGOs) protest the results as a sell-out of both poor countries and the environment (Josling, 2003).

Agricultural "Laissez Faire" May Not Be the Answer

Some claim that further liberalization of agricultural markets, accompanied by cuts to current subsidies, would provide solutions while others argue that the problems may be caused more by the concentration of market power within large agribusiness conglomerates (Wise, 2004; Vorley, 2001). If the latter is true, further liberalization would speed up the restructuring of markets toward closed supply chains and cuts to farm support programs would only entrench binding ties between remaining farmers and the integrators that increasingly hold contracts on every aspect of farm production. Although this might be more noticeable in the developed worlds' farmers in the short run, it is a result that would soon affect all farmers throughout the world.

When supply chain analysis is combined with political economy, results show that the traditional supposition that capital is accumulated through control of tangible means of production [land, labor, water, etc.] is increasingly incorrect; ownership and control of the intangible assets [information, brands, patents, etc.] is where the true power resides (Vorley, 2001). Furthermore, as found by the Organization for Economic Co-operation and Development (OECD): "…there is concern not only that oligopolistic retailing and processing structures will lead to abuse of market power but that the lion's share of the benefits of any future reforms in the farming sector may be captured by the processors and retailers…"

From available studies, it is unclear that changes to farm programs in the developed world would produce significant changes in production levels or world commodity prices. It is more likely that the major food-exporting countries will find a political solution that continues the status quo - ongoing support for their farm sector coupled with movement toward market liberalization - for some period of time. Further complicating the situation is the influence of general economic forces that have not yet been examined in any detail. Some of these factors include:

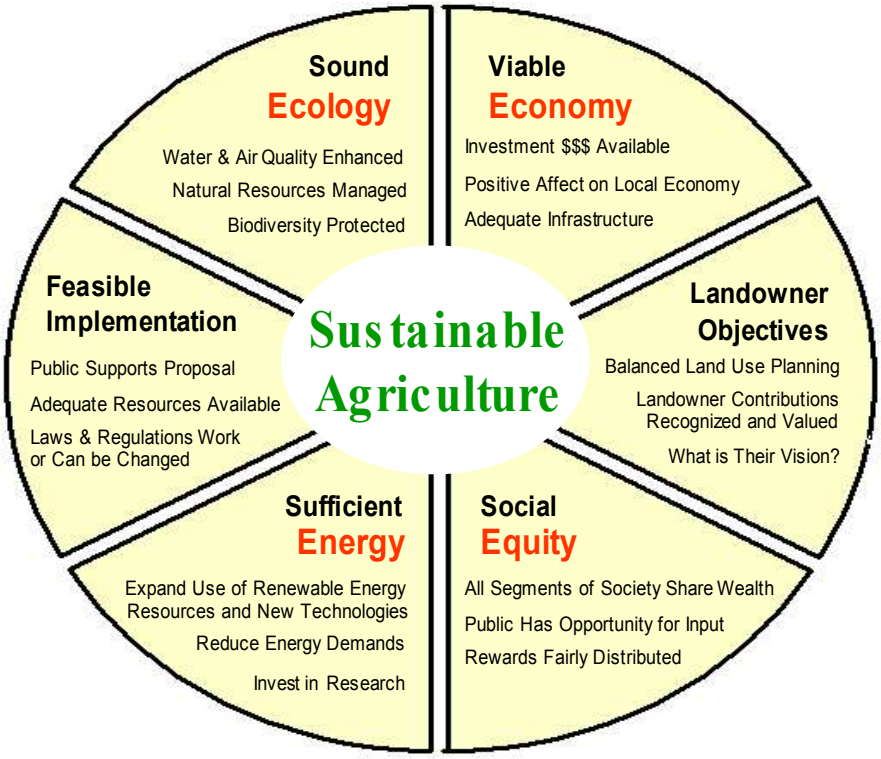
- High demand for land for various non-agricultural purposes, including residential needs and leisure pursuits.
- Changing occupational expectations and a move away from physical labor.
- Opportunity costs of farming have risen while the associated rewards have diminished in many producers' minds.

Seeking Policies that Advance Agricultural Sustainability

Farm policies based on "sustainability" would be quite different than those seen in the current, and previous, US Farm Bills (Ikerd, 2002). The same can largely be said for the EU Common Agricultural Policy (CAP), as well as most farm policy throughout the globe. This also includes the common practice within most developing countries of extracting surplus from the rural farming sector to fuel urban growth and industrialization, for example:

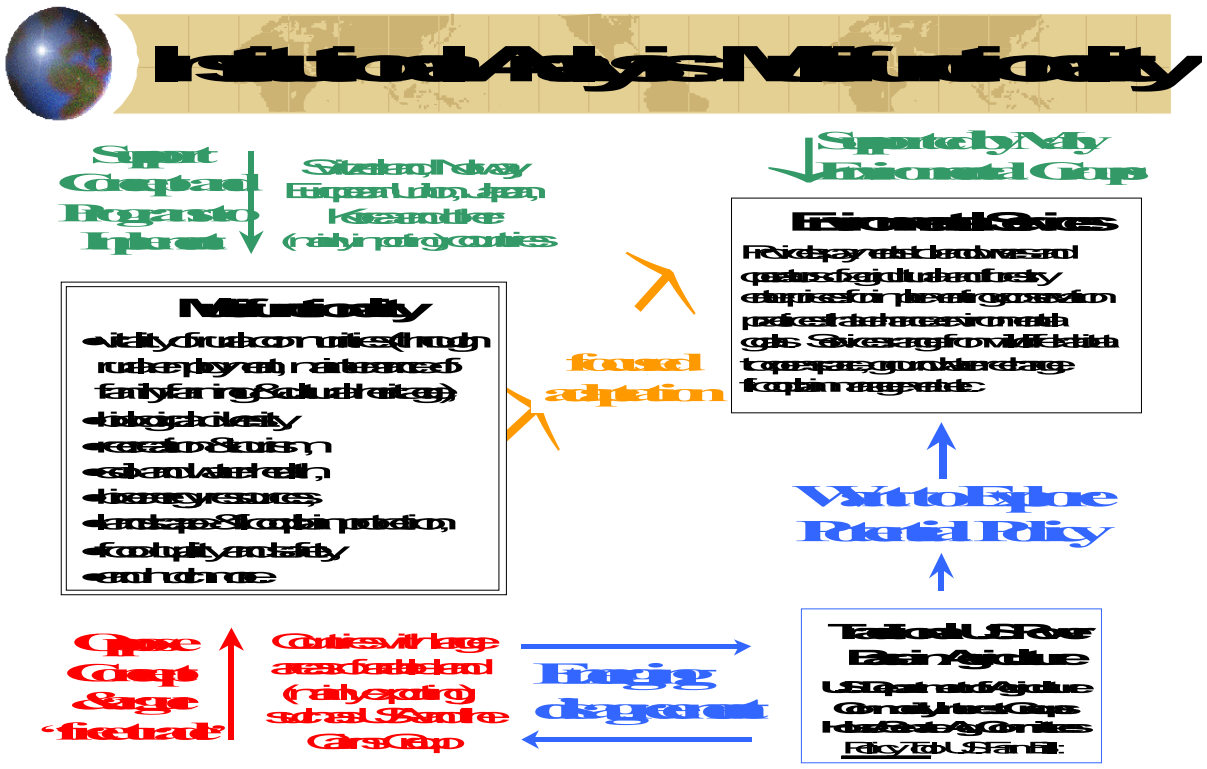
> *"A major reason for this [the domination of larger farmers] was the bias of public policy which systematically channeled scarce resources to the larger and more prosperous farmers. Although policy aggravated inequality in the countryside, it had virtue, from the view of the government, of encouraging commercial agriculture and thereby augmenting the marketable surplus. Given the needs of urban areas for cheap and abundant wage goods . . . the best thing that could have happened, did happen: the "green revolution" strengthened those in the countryside who were the natural allies of the urban ruling groups…. " (Griffin, 1974)*

Although the three "E's" - Ecology, Economy, and Equity - have become the common definition of "sustainability," they do not fully encompass all elements that must be considered. As shown to the right, many other factors need to be both better understood and integrated into policy.



Additionally, some sense of equity between the present and future generations must be examined and accounted for. The challenge for policy makers is to balance desires for public welfare and market efficiency.

The need is to find policies and programs that will enable progress toward a "sustainable" form of agriculture. More recently, articles also suggest that some form of multifunctionality may be a basis for sound farm policy in the developing world as well as the advanced economies (Losch, 2004; Vorley, 2001). Multifunctionality recognizes and rewards the benefits - other than food or fiber - that can come from agriculture, yet often go uncompensated in the marketplace and that can vary tremendously depending on farming practices. Although very similar to the concept of compensating for "environmental services," as an instrument to change modes of production, multifunctionality also attempts to deal with socio-economic concerns and needs.



Research Agenda: Exploring Multifunctionality as Farm Policy

> **Hypothesis:** Policies based on multifunctionality produce a more sustainable form of agriculture, a healthier environment, and a stable rural economy. Implementing such policy in the US Farm Bill would guide public investments toward increasing the broad array of external benefits – beyond just food and fiber – produced from agriculture.

Utilizing the Extended Case Method (Burawoy, 1998), this research will analyze the potential of two policy frameworks on the agricultural sector: 1) multifunctionality as practiced by some EU governments; and 2) an "environmental services" initiative currently underway in Florida - the Rural Lands Stewardship Program. There are many variations in how individual nations, and states, implement their programs. Some key questions that need to be answered include:

- How to ensure that multifunctionality is not used to justify trade barriers?
- How to explicitly identify the externalities due to multifunctionality and how to value them, using standard market and nonmarket valuation techniques?
- Where is the appropriate level of support for agricultural operations as well as other natural resource-based activities?
- What roles do rural communities and regional economies play in such calculations and what rewards should they rightfully expect?

- Will this policy, and consequent programs, actually deliver improvements to ecosystems and overall environmental health?

During all phases, results and recommendations will be tested against a diverse array of competing interests. This "testbed" will encompass 100+ individuals, selected from key interest groups, government agencies, and academic disciplines. Participants will encompass a diversity of economic status, geographic regions, age, familiarity with the subject, political opinions, etc. These participants will periodically review findings and - utilizing appropriate survey instruments - comment on results and concepts as they are being developed. Such input will be carefully documented and incorporated into the developing framework as appropriate.

Using the previously identified elements of sustainability, an examination of the various policy frameworks, is expected to produce the following results:

	Sound Ecology	**Viable Economy**	**Social Equity**	**Sufficient Energy**	**Landowner Objectives**	**Feasible Implementation**
U.S. Farm Bill						
Env. Services						**?**
Multifunctionality					**?**	**?**

= Positive **= Neutral or Mixed** **= Negative**

Conclusion

If potential ecological and social benefits of agriculture are to be realized, new programs must create incentives and alternative means of investment into agriculture, rural landscapes and our rural communities that ensure both food security and ecological sustainability. Redirecting farm policy in this direction will be an uphill battle against entrenched interests and deep-seated fears regarding change; however, preliminary work indicates a willingness to explore alternative agricultural policies that is much higher than anticipated (see Appendix A).

By combining traditional knowledge of agricultural policy and economics together with the disciplines of rural development, ecosystem management, political economies, regional planning, social justice and institutional analysis, this research will uncover new relationships and expand knowledge in both agricultural and environmental policy.

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Appendix A: Survey Results from Test Interviews

To assess the use of a testbed of competing interests, a trail run was conducted in April 2004. The ten individuals selected covered a wide range of geography, educational level, partisan positions, interests, and knowledge of the subject. Interviews were done in an informal manner by telephone and generally lasted 30 minutes. After questioning the existing knowledge level for the various policy frameworks, a definition of each was offered prior to a more wide-ranging discussion of opinions and ideas that the participants had on the topic. Summary of results are:

Knowledge of: US Farm Bill
Very knowledgeable of entire Bill: 2
Know one or more titles/programs but little of the rest of the Bill: 5
Know very little about the Farm Bill: 3

Knowledge of:
Multifunctionality
Fairly Good Understanding: 1
Some Understanding: 4
Little or no knowledge: 5

Knowledge of: Environmental Services
Fairly Good Understanding: 4
Some Understanding: 4
Little or no knowledge: 2

Would Multifunctionality work in the US and what are potential challenges?
All were curious about the concept and would like to know more!
All pointed out the need for a lot of education on the topic.
Most thought it would be very difficult to get farmers to buy into this.
5 pointed out that agricultural committees and agribusiness will probably fight it.
3 expressed concern that urban public won't understand the value to themselves.
3 pointed out that a simple reluctance to institute change might be a problem.
2 felt if looking at all USDA programs, we were already close to implementing this.
1 mentioned concern about availability of money in the current budget state of affairs.

Would Environmental Services work in the US and what are potential challenges?
All pointed out the need for a lot of education on the topic.
Most were somewhat familiar about the concept but recognized need to know more!
Most felt that there was potentially widespread support for concept if handled well.
4 felt that the Conservation Title was already close to employing this concept fully.
3 pointed out that farmers may be dubious and might fight it.
3 expressed concern that environmental groups may mistrust programs' intentions.
2 pointed out a need to focus on the natural resources for allocation and implementation.

Conclusion

This trial demonstrates a willingness to explore alternative agricultural policies that is much higher than anticipated. Of major surprise were comments indicating that existing US Farm Bill policy may already be approaching both multifunctionality and/or environmental services. Attitudes seem to be more geared toward "how" this work should proceed rather than whether it was worth pursuing at all – a very positive development! Further work is needed to refine actual research techniques and identifying participants for the full testbed - 100+ individuals.

Soil and water conservation practices and improved livestock farming systems for sustainable agriculture and food security achievement in the semi-arid region of Burkina Faso

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Institute for Environment and Agricultural Research

Abstract

Mixed crop-livestock smallholder farmers in the northern region of Burkina Faso are faced to environment uncertainty and the main constraint is natural resources degradation. This case study on best practices indicates how can combined soil and water conservation practices and improved livestock farming systems enhance sustainable agriculture and food security achievement? This study highlights the role of success factors such as the relevance of agricultural innovations generated, the existence of investment support for farmers, the demand-driven approach developed for innovation process and, farmers' connection to markets.

Introduction

The northern region of Burkina Faso is characterized by a Sahelian-soudanian climate in its south part and a Sahelian climate in its north part (Fontes and Guinko, 1995). The mean annual rainfall amount goes from 300 to 600 mm, with pronounced rainy and dry seasons. The main characteristic of the rainfall is irregularity in time and space. Soils have a strong tendency to seal and crust and have a low organic matter content (< 15 g kg^{-1}), low nitrogen content (< 0.7 g kg^{-1}), and low available phosphorous (< 0.06 g kg^{-1}).

Mixed crop-livestock farming system is the current major practice, and agricultural production is presently dominated by cereal-based systems, which are 97% rain-fed (FAO, 1995). In this zone, the combined effects of climatic conditions, poor soil quality and human

activities has resulted in soil degradation, due to crusting, sealing, erosion by water and wind (Zougmoré *et al.*, 2000) and the loss of nutrients through erosion and runoff (Roose, 1981). Because of the degradation phenomenon, crop production and animal production are at risk (Mando and Stroosnijder, 1999). To solve the degradation problem, farmers have developed a range of measures, including runoff control, soil structure improvement, and nutrient management (Mando et al., 2001). Indigenous as well as introduced soil and water management practices like stone rows, mulching, *zaï* pits, and half-moons, are increasingly being used by NGOs, development projects and public bodies to rehabilitate soils in the Sahel (Reij et al., 1996). Animal production has a great importance in this area, for being a source of cash, animal manure, and for playing a strategic role in risk reduction for rainfed agriculture (Zoundi *et al.*, 1994; Zoundi, 1997).
This case study reports briefly the effect of some of theses practices on soil productivity, crop performance, income generation, and food security. Several research studies have been conducted by the national research institute for agriculture and environment (IN.E.R.A) with the collaboration of IFAD (International Fund for Agricultural Development) project (CES/AGF) in Burkina Faso, and of the Canadian International Development Research Center (IDRC) regional project "*Crop-livestock integration and sustainable natural resources management*".

1. Technologies promoted and their effects

1.1. Soil and water management practices

Stones rows

This technique consists of two rows of laterite rocks placed in a furrow dug with a subsoiler or pick. The upslope row is of large blocks (35 cm x 25 cm) of stones partly buried (5 cm depth) in the soil while the downslope row consists of small stones (15 cm x 15 cm) placed so as to stabilize the first row. The earth excavated from the furrow is replaced along the stones to fill up remaining holes in the soil. The heap of stones weighs about 80-90 kg m^{-1} and is about 20-30 cm high from the soil surface.

Study by Zougmoré et al. (2000) clearly showed that under water limiting conditions, the stone rows technique was efficient in improving soil water content through runoff control. Under water limiting conditions, crops in plots with stones could yield two to three times more than crops in control plots, but under heavy rain conditions, stone rows could be harmful to crop production as they can create waterlogging conditions. More over, supplying compost or animal manure in combination with stone-rows resulted in sorghum grain yield increase of about 180 %.

Photo 3: Water retention upslope a stone row in a farmer's field after a heavy rainfall, Poa village, Burkina Faso (Photo by R. Zougmoré)

Zaï and half-moon techniques

The *zaï* technique is a complex system for restoring the productivity of degraded soils by concentrating runoff water and organic matter in basins dug during the dry season (Roose et al., 1999). It consists in digging small pits 20-40 cm in diameter and 10-15 cm deep in order to collect runoff water. Average sorghum crop density is 31750 *zaï* holes (0.80 x 0.40 m) per hectare. A handful (0.3 kg) of animal manure or compost is supplied per pit, i.e. 9.5 t ha^{-1}. Compost is produced in a compost pit.

The half-moon is a runoff water collection device, mainly adapted to the Sahelian and Sudano-sahelian zones where it is made on gentle slopes (< 3%). The basin in each half-moon was dug with a hoe or a pick so as to break the crusted layer on the soil surface, and to collect the runoff water. In each half-moon the cultivated area was 6.3 m^2. According to usual practice, animal manure or compost were supplied at a dose of 35 kg (a barrowful) per half-moon, i.e. 14.6 t ha^{-1}. Soils are totally bared and very degraded (soil depth: 30 cm, pH (H_2O) < 5, SOM (1.2 %), N (0.6 g kg^{-1}), total P (0.66 g kg^{-1}), CEC (0.11 cmol kg^{-1})).

It was found that applying compost or animal manure, with or without local phosphorus fertilizer, allowed yields of from 600 to 1600 kg ha^{-1} of sorghum grain, i.e. 24-39 times the yield obtained in the half-moon treatment without any amendment (Zougmoré et al., 2003). Adding local rock phosphate in the *zaï* holes induced sorghum grain yield to increase by 63 %. Merely breaking up the surface crust to improve water infiltration did not increase sorghum yield. This study showed that on a degraded *zipellé*, the mere fact of restoring favorable soil moisture conditions is not enough to improve crop production. The removal of the water constraint by destroying the surface hard pan reveals the second major constraint, which is the chemical poverty of the soils in this area. Well decomposed OM such as animal

manure and compost applied in the *zaï* or half-moon holes, are the best substrates that can provide sorghum plants with the nutrients required for growth. Moreover, adding local rock phosphate to compost or mulch appeared to be an interesting alternative for improving soil productivity.

Photo 4: Zaï pit, with sorghum plant in a farmer's field at Pougyango, Burkina Faso, 600 mm

Photo 5 : Half-moon, with sorghum crop variety I RAT 204 at Pougyango, Burkina Faso, 600 mm annual rainfall (Photo by R. Zougmoré)

Table 1: Effect of half-moon and *zaï* practices on sorghum performance in 1998 and 1999 at Pougyango village, Northern Burkina Faso (kg ha^{-1})

	Grain yield		Straw yield	
	1998	1999	1998	1999
Half-moon + animal manure	**1614 a**	**1104 a**	**4291 a**	**2542 a**
Half-moon + compost + rock phosphate	**927 b**	**1104 a**	**2729 ab**	**2479 a**
Half-moon + compost	**1000 b**	**875 ab**	**3125 abc**	**2458 a**
Zaï + animal manure + mulch + rock phosphate	**708 bc**	**694 bc**	**3906 ab**	**1619 abc**
Zaï + animal manure + mulch	**438 cde**	**181 de**	**2395 abc**	**744 bcd**
Zaï + animal manure	**375 cde**	**206 de**	**2125 bcd**	**725 bcd**
Half-moon	**41 de**	**42 e**	**114 e**	**177 d**
T0 (control)	**0 e**	**0 e**	**0 e**	**0 d**
Signif. 5%	**HS**	**HS**	**HS**	**HS**

Treatments with the same letter are not statistically different at p= 0.05; Signif. 5%: significance at p< 0.05; HS: highly significant.

Mulching

Studies by Mando (1997) in this region showed that mulch, when placed on a crusted and bare soil, can trigger termite activity within a few months. Termite activity results in a change in soil structure. The combination of the increase of porosity and infiltration and the cover effect of mulch results in an increase of soil water availability in the soil profile during the growing season. Termite activity enhances decomposition of the mulch and hence nutrient release in the soil. The change of soil characteristics due to termite activity was enough to create conditions necessary for natural vegetation development and crop production on previously degraded bare soils. Farmers in this zone sometimes burn the mulch before sowing. It is reported that using soil surface mulching, sorghum yield can reach on this degraded soils, 700 to 800 kg ha^{-1}, which is the average sorghum yield in common cultivated fields.

Some farmers combine on the same plot many technologies to somehow rehabilitate quickly the degraded *zipellé*. This was the case of a farmer of Bogoya village who used stone rows, zaï pits, mulching, and tree planting techniques to rehabilitate and intensify crop production on an abandoned *zipellé*.

1.2. Role of improved livestock practices

Investigations in the region by IDRC project indicated that sheep fattening system has impact on mixed crop-livestock farms in this part of Burkina Faso, as it induces income increase, and improves food security. Fattening diets based on farmers' knowledge and including local feeds (70% in the diet), such as crop residues, forage trees, and others resources available in the farm, are of great importance in these mixed crop-livestock farming systems. Economical

impact of these fattening diets through Linear Programming Model indicated that farm engaged in such a fattening with 5 rams during a good rainy season and 11 rams the dry or bad rainy season can generate sufficient income level to ensure self-sufficiency by affording the respective cereals extra-needs of 585kg.year^{-1} and 1426 kg.year^{-1} while generating profit. Moreover, fattening 11 rams allows production of compost manure for an additional 4.31 ha compared to the traditional practice (table 2).
Theses practices increase the role of livestock in the mixed farming systems, and allow farmers to produce more organic fertilizer for soil and water conservation techniques such as *zaï*, half-moons…

Table 2. Improved livestock management in mixed crop-livestock farming system and food security achievement in the Yatenga zone, North-West part of Burkina Faso

	Areas fertilized with animal manure (ha)	Number of goats sailed to purchase food		Additional profit (F CFA) made after food purchase	
Quality of rainy season	-	Good	Bad	Good	Bad
1. Control (without any livestock intensification practice)	2.92	2	8	11,398	8,637
2. Alternative 1: Fattening 2 rams/farm	3.70	1	6	7,607	5,743
+ Diet 1		1	6	3,243	1,379
+ Diet 2					
3. Alternative 2: Fattening 5 rams/farm	4.88	0	4	14,871	13,902
+ Diet 1		0	4	3,961	2,992
+ Diet 2					
4. Alternative 3: Fattening 11 rams/farm	7.23	0	0	81,198	30,219
+ Diet 1		0	0	57,196	6,217
+ Diet 2					
5. Alternative 4: Fattening 30 rams/farm	14.68	0	0	291,236	240,225
+ Diet 1		0	0	225,776	174,765
+ Diet 2					

Source: Zoundi *et al.* (2004)
Diet 1 : Local feeds resources: 83% (15% sorghum straw, 32% cowpea husk, 36% *Piliostigma reticulatum* pods), 17% cottonseed cake
Diet 2: Local feeds resources: 83% (15% sorghum straw, 30% cowpea husk, 38% cowpea haulms), 17% cottonseed cake

2. Lessons learned

Farmers' access to innovations for sustainable agriculture in this case study is mainly due to the combination of many factors.

2.1. Role of project interventions: Support for investment

Projects interventions in soil and water management activities are very helpful for farmers, which don't have sufficient means to realize theirs land management themselves. The IFAD project on soil and water conservation and agroforestry (CES/AGF) helps farmers with equipments for contour lining, furrow digging, laterite rock transport, and compost pits realization. Framers input consists essentially in labor input during the whole process of

elaborating activities to theirs realization on fields. The principle of participatory approach is appeared to be very successful as many farmers which benefit from the project activities claim that thanks to this collaboration, their land productivity have increased significantly. Indeed, 7 years after the project has started, farmers became more aware about the degradation problem and are able to choose the appropriate technology that have been evaluated on theirs own fields by INERA researchers.

2.2. Demand-driven approach developed

Innovation process developed through IFAD and IDRC projects is mainly oriented by demand-driven approach. This participatory technology development (PTD) included diagnostics, co-definition of research protocols with farmers, implementation and evaluation. All research activities are based on farmers' demands, fitted on their local conditions, and were managed by producers. This approach give and opportunity for farmers to add their knowledge and skill in innovation process. So, many indigenous innovations (*zaï* pits, mulching…) developed by farmers have been concerned in the process. This is one of the major factors of great success.

2.3. Farmers' connection to markets

Innovation process like animal fattening practice, legume production…, give opportunity for farmers to be more connected to markets and to generate additional income for food security achievement. This environment have been an incentive source of motivation for farmers to invest for technology development and valorization.

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Multi-stakeholder Analysis of Policy and Institutional Priorities for Sustainable Agriculture and Rural Development[8]

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Abstract

This paper presents the salient results of a sustainable agriculture and rural development (SARD) analysis conducted on three major farming systems of the world. The case studies were carried out on three regionally important farming systems, i.e. the maize-beans systems of Central America, the cereal/root crop-based system of West Africa, and the lowland rainfed rice-based system of South East Asia. The main steps of the methodology included: the selection of focus regions and farming system of the country, institutional organization, understanding the strengths and weaknesses of the present system, analysis of past evolution and future scenarios, and the identification and analysis of the main policy and institutional priorities for achieving SARD. Emphasis is placed on the relevance of the case study methodology, the lessons learnt and on the future policy and institutional challenges relevant to farming systems development.

Background

Today the rural areas and rural people in developing countries face some very serious challenges. Poverty is concentrated in rural areas: two billion farmers live in poverty; smallholders and rural land-less account for 75 percent of the hungry and undernourished people in the world; so many people want to get out of agriculture and many will try to emigrate to richer countries. People who live in villages cannot support themselves adequately; they lack access to the needed inputs (i.e. land, water, technology, seeds, animal breeds and credit). Some 60% of the world's natural resources (i.e. ecosystems, forests, farmlands, rivers and lakes) are threatened as never before by current patterns of production and consumption; exhausted soils, falling water tables, polluted streams, denuded forests, declining biodiversity. Conflicts, natural disasters, and pandemics such as HIV/AIDS exacerbate these problems – and often result from them.

Public investment in agriculture and rural areas is at an all-time low, having been drastically weakened by structural adjustments, which explains why technical assistance services for small farmers have virtually collapsed. Important decisions about rural areas are made in the cities or are dominated by local elites and agribusiness lobbies; local cultures and interests are ignored, and current policies usually work against small-scale, weak stakeholders. Frustrations easily boil over into violence.

Governments are committed to the Millennium Development Goals, Agenda 21 (Rio de Janeiro and Johannesburg summits) and other international agreements that aim, among other things, to cut poverty and hunger in half by 2015. Honduras, for example, has set such targets under its national Proverty Reduction Strategy.

[8] Statements, designations and country boundaries presented in this paper do not necessarily express any policy or opinion on the part of Food and Agriculture Organization of the United Nations

Sustainable agriculture and rural development is people-centred, and aims to achieve an agricultural and rural sector that is productive, viable, and capable of satisfying the cultural, social and economic aspirations of rural people, without compromising the ability of future generations to do the same. To achieve this objective, a coherent set of public policies, institutions, programmes, technology and investments are needed to enhance the livelihood options and wellbeing of rural people, in particularly the rural poor and vulnerable groups. These policies and programs must be driven at national, territorial and community levels by the rural people and the rural poor.

The SARD-FSE Project

In recent years, global interest in Sustainable Agriculture and Rural Development (SARD) has grown along with the recognition of the dynamic, complex nature of the challenges facing rural areas and communities. Yet, the means for assessing policy, change and options for the future are often lacking for decision-makers operating at the local, territorial, national and regional levels. Developing countries are also often confronted with shrinking resources and dramatic demands to increase food security, to alleviate poverty and to conserve natural resources and the environment, criteria at the core of SARD.

To respond to this situation, the SARD-FSE Project aims to enhance the capacity of governmental and non-governmental institutions to plan, implement and evaluate SARD policies and strategies. The project also aims to promote an environment favorable to open policy dialogue among all stakeholders and to ensure that the necessary conditions are in place to foster such dynamic processes. The stakeholders involved in the different phases of the Project include government agencies (e.g. ministries of agriculture, rural development, environment, planning), NGOs/CBOs (e.g. community based organizations, peasant community and farmer organizations), private sector enterprise (e.g. input supply, processing, product marketing), agricultural education and extension institutions, agricultural research centers, and external cooperation and donor agencies. SARD is not possible without the active participation of the stakeholders who can make it happen and who must work together at the local (district) and territorial (province) levels, but must also be knowledgeable of national priorities and resources that can be leveraged for their local development efforts. They must be enabled to take a more active part in determining these national priorities. It is particularly important to involve marginalized groups such as the landless, the poor, women, young people and indigenous peoples.

The Conceptual framework and methodology

The conceptual framework for the project relies on these four “pillars”, each of which has specific objectives which are defined and prioritized by the stakeholders in some collegial manner, e.g.,

- **Culture** To promote cultural freedom and diversity and to enrich the positive values of local cultures. This involves considering what people treasure in their lives, their values or what they mean by “wealth” in human, social or physical terms. Culture is expressed in religious beliefs, perceptions, community relations, creative arts, as well as in people’s food and nutrition practices. Cultural freedom embraces all these dimensions.

- **Social** To reduce rural poverty and food insecurity and to improve social equity among citizens, irrespective of gender, religion or race. Equity requires a special focus on the poor and vulnerable groups in rural society.
- **Economic** To improve competitiveness and to promote economic growth. To be viable, farms and other non-farm economic activities have to be profitable. They must use local and external resources efficiently, manage their enterprises and markets well, and diversify their options so they can optimize their income and minimize their risks.
- **Environment** To conserve natural resources (e.g., land, water, forests, biodiversity) and to protect the environment (e.g., prevent air and water pollution, manage wastes, provide environmental services).

To analyze the status, driving factors and potentials of sustainable agriculture and rural development, the approach comprises the following attributes:

- **Participatory and bottom-up** This involves building ownership among local people and stakeholders in the public, private, and non-government sectors. Though the poor and marginalized are the primary focus, the elite and the powerful must be involved for meaningful change. Donors are another key group of stakeholders.
- **Holistic** Covering all four pillars, taking into account their interactions and tradeoffs, as well as the interdependence between the local, regional, national and global systems.
- **Cross-sectoral** Focusing on a wide spectrum of potentials and opportunities in agriculture, natural resources, industrial and service sectors and including the linkages and synergies with the urban sector.
    - **Interdisciplinary** Promoting interaction among biophysical, social and other disciplines to gain an understanding of complex systems, people's needs and objectives, and development potentials.
- **Gender-sensitive** Recognizing the importance of gender issues, across age groups, and their implications of access to assets, management of production, distribution of benefits, and other decision making processes.

The agriculture and rural systems can be analyzed in terms of its key components (e.g. the people, natural resources, production of goods and services, markets for inputs and products, and finance and investment) and key change processes (e.g., policy and legislation, Institutional development, work programme, technology development, partnership development). Table 1 shows how the components and interventions described above can be related to each other. Effective coordination and harmonization of interventions for agriculture and rural development means that the analytical framework considers the horizontal as well as the vertical linkages and synergies. The specific combination of interventions is dictated by the relevant context, priority goals, resources available, etc. In brief, policy interventions (in particular cells) must be assessed in terms of their implications on other components as well as their requirements of effective delivery, i.e. institutional, programmatic, technological and partnership requirements.

Table 1 Matrix for defining action programmes for sustainable agriculture and rural development

Components	Interventions in key processes				
	Policy	Institutions	Programmes	Technologies	Partnerships

People	Governance, human rights, rural people, education, culture, youth, indigenous peoples, gender	For capacity building for farmers & communities, gender, youth, HIV/ AIDS, advocacy	For governance, education, skill development, health, housing, etc.	For education, health, knowledge management, preparedness	Among national & local governments, NGOs, community organizations, religious orgs
Natural resources & environment	On land use, tenure, natural resources, energy, livestock, fisheries, protected areas, biodiversity, climate change	For land tenure, natural resource management, environmental protection, climate change	For integrated natural resources management, water, livestock, forests, fisheries, bio-prospecting	For agroforestry, land rehab, sustainable livestock/ forest/ fisheries, water use, energy use, waste management	Among national & local governments, NGOs, CBOs, research institutes, universities
Production & income generation	On foreign exchange rate, interest rate, labour laws, migration, remittances	For credit, research, extension, input and business services	For indigenous knowledge, good practices, technology dev, diversification, business services	For germplasm, efficient land, water, energy or labor use; livestock; IPM, value adding, tourism, environ services	Among government, private sectors, research institutions, universities, FAO
Markets & trade	On agricultural and food prices, risk management, trade agreements, food safety, exports	For marketing, price stability, governance and management of food chains, fair trade	For market development, marketing information & services, trade promotion	For communication, market promotion, diversification, food safety and standards	Among governments, private sectors, World Trade Organization, FAO, etc.
Finance & investment	On fiscal expenditure, investment, interest rate, foreign investment, debt, remittances	For savings, credit, banking, insurance, contract farming, mortgages, infrastructure	For foreign invest ment, user/tourist fees, environmental services, clean dev mechanisms	For supply and access to food, M&E, enterprise/financial management	Among national government, multilateral and bilateral, business sector, local governments

FAO's **Sustainable Agriculture and Rural Development-Farming Systems Evolution project** has applied procedures, based on the above concepts and principles, to enable local people and other stakeholders to contribute to appropriate policies and interventions that address the cultural, social, economic and environmental priorities of local communities, including the rural poor and marginalized people. In the course of a year and half, the project has tested decision-support tools and resources to strengthen the capacity of decision makers, professional staff and community-level stakeholders through joint planning of the case studies, joint analysis and improvement of the proposed methodology, field implementation of the case studies, and validation of the case study outputs.
For the case studies, three major farming systems were selected in rious parts of the world:

- The **maize/bean-based farming system** in the departments of Lempira Sur and Santa Barbara, Honduras. This is a traditional food production system of Central America, dating back to the pre-Columbian period.
- The **cereal/root-crop based farming system** in the region of Sikasso in southern Mali. This system is crucial for food security and poverty reduction in West Africa. In the case of Mali, it is closely intertwined with the cotton production industry.
- The **lowland rice-based farming system** in Nueva Ecija in central Luzon, Philippines. This type of system feeds 860 million people in the world.

More detailed characteristics of each system, using secondary sources and case study results, are presented in Table 2, to understand the socio-economic importance, management and productivity/livelihood situation in these selected farming systems.
The procedure is described in detail in a manual, ***Participatory policy development for sustainable agriculture and rural development***, which was prepared for national policy makers, donors, researchers and educators who are concerned with policy and institutional issues in rural areas. The procedures applied in the three case studies falls into five steps:

Step 1 Institutional organization The getting-organized phase includes forming a steering committee of representatives of key stakeholders (i.e., public, private and civil society sectors), identifying partners and determining the approach you will use and obtaining the resources needed, also providing support for forming a team to manage the policy development process, A national coordinating committee (NCC) is formed that guided and provided oversight of the project in each country. For example, the government participants on the NCC were two ministries in Honduras (Agriculture and Natural Resources), four ministries in Mali (Agriculture, Environment, Social Development, and Promotion of Women), and three departments in the Philippines (Agriculture, Agrarian Reform, and Environment). A lead institution was selected to manage the national technical team implementing the case study. This team was multi-institutional and multidisciplinary, comprising usually 5 specialists, each with expertise in policy, socio-economic, technological, environmental and/or participatory methods. The FAO staff worked closely with the national teams as a global team, adapting the methodological guidelines, comparing results, learning from and assisting each other in the implementation process. The global team (FAO project staff, three team leaders and the national technical team of the host country) met four times at the critical stages of the project and in different venues: March 2003 in Manila, June in Tegucigalpa, November in Rome and March 2004 in Bamako.

Step 2 Territorial and farming system selection: Select the focus area, involves deciding what area to study in the process based on the analysis of the social and economic importance of the farming system for the region and country. This step includes deciding on criteria to select this focus area, gathering data on the topics, initial discussions with stakeholders and with local authorities, and identifying the locations for detailed case studies or interactions with local stakeholders.

Table 2 Characteristics of the major farming systems selected in Honduras, Mali and the Philippines

	Maize-beans – Honduras	**Cereal/root crop – Mali**	**Lowland rainfed rice – Philippines**
Regions & countries with farming system	México, Guatemala, El Salvador, Honduras, Belize, Nicaragua, Panamá	Senegal, Mali, Burkina Faso, South Chad, Sudan Mozambique, Angola, Zambia	East- and Southeast China, west Korea, Mainland Southeast Asia, Java, Sulawesi, Philippines
Regional importance of farming system	Population supported: 77 m. in total, 11 m. agricultural, 1.4 m. producers; cultivated area more than 6 m. ha (2 m. ha irrigated)	Population supported 85 m. in total, 59 m. agricultural; cultivated area 31 m. ha (< 0.5 m. ha. Irrigated)	Population supported: 825 m. in total, 474 m. agricultural; cultivated area 71 m. ha (33 m. ha irrigated)
National & institutional context	HDI rank 115; Independence 1821; ex-Spanish colony; democratic since 1982; per capita income of $2,600; poverty 53%.	HDI rank 174; Independence 1960; ex-French colony; democratic since 1991; per capita income of $900; poverty 64%.	HDI rank 83; Independence 1898 (ex Spain) & 1946 (ex-USA); democratic since 1992; per capita income of $5000; poverty 40%
Environment	Agriculture affected by El Niño and tropical thunderstorms; high altitudes and broken topography; rainfall 1200-2200 mm/year; clay-like soils, suitable for different crops	High incidence of drought, soil degradation & diseases; rainfall 600-1300 mm/year, highly variable & declining; ferruginous, unstable & degradable soils; lack of mineral or organic inputs reduce yield & cause desertification	Rainfall variable & unpredictable; droughts (El Niño) & typhoons; rainfall 1,873 mm/year; soil erosion, sandy soils & flat topography with good potential for agriculture

Production factors	**Land:** high incidence of unequal land distribution (only 1.3% of all farms have more than 50 ha, while 90.7% have less than 10 ha); average farm size 3.5 ha; fragmentation due to population growth. **Labour:** average HH size 5.5; farming uses all HH labour but creates little demand for hired labour; off-farm employment yields incomes but limited in region & available elsewhere in country, El Salvador and USA, hence import of remittances. **Capital & infrastructure:** lack of roads & other infrastructure, esp. irrigation, education (but increase in No. schools & roads) & health facilities; irrigation not important for maize-beans but yes for diversification; formal credit available at interest rate of 28%; low use of agro-chemicals	**Land:** size for parcels increasing, from 0,86 to 2 ha for cotton, from 1 to 4 ha for cereals, while they are much smaller for tubers at 0,05 ha; there is almost no regular market for land, instead managed by traditional law. **Labour:** average HH size 5.9; off-farm employment hardly available in local area, so long-term migration occurs regularly & increasing significance of remittances. **Capital & infrastructure:** most available infrastructure for cotton production, but mixed systems profits from it; even cotton prod is rainfed; on average low use of technology; availability of draught animals increased significantly; credit & inputs available only for cotton farmers	**Land**: land frontier almost reached, thus intensification; farm size 2.28 ha; 10-30% landless; fragmentation due to population growth, most farmers are owner-cultivators, many farmers indebted & land consolidation trend by moneylenders/ landlords. **Labour:** HH size 4-6; on-farm work as main activity, some additional work as farm labourers; farm-labour demand increased with new varieties, hence formalization of labour markets; **Capital & infrastructure:** 46% without electricity (Talugtug); use of technology low due to high prices & insufficient training; also, formal credit insufficient, with rates 30-40% from formal sources, & 30-90% from informal ones; seed varieties used & chemical fertilizer overused; need for more irrigation, a primary input
Production & income generation	**Production:** 1.4 t/ha for maize, 0.5 t/ha for beans, both well below potential for meso-American sites; production diversified into coffee, livestock, citrus, vegetables, both for HH use & income generation; farm production: 75% for consumption, 5% invested, 20 % for covering loans & other expenses; marketing improved with access to El Salvador market **Income & poverty:** On- & off-farm income $1789 (national: $2,278); most on-farm income from beans & vegetables & maize for self-consumption; 65% of HH get their income from agriculture; poverty incidence 53% (1993).	**Production:** 1.2 t./ha for cereals, decreasing from 1.4 t./ha in 1993; cotton is cash-crop, while cereals are for HH consumption, 15% production marketed; citrus & vegetables also important, but suffers from insufficient infrastructure (i.e. storage & processing); 80% rise of cotton production due to increase of land, & rest from yield rise **Income& poverty:** Poverty incidence 65.8	**Production:** 2.2 t./ha, equal 30% less than irrigated rice; rice yield declining; cash crop production low, due to insufficient training & technology; most vegetables used for home consumption **Income & poverty:** Rice income/year 10,000-12,000 P; 40,000-180,000 P for irrigated rice; HH income/year 30,000 P for pure rice farms, 780,000 P. for farms with rice, other crops & livestock; at least 50% of HH income from non-farm activities; rising tendency of off-farm work (as seasonal labourers); 5-10% of HH have members work abroad; Poverty incidence 46.9%

Step 3 Analysis of the current farming system. The analysis of the current situation includes asking local people to identify their development goals, identifying indicators to measure progress towards these goals, analyzing the current situation in agriculture and rural development at national, regional and local levels, and diagnosing the strengths, weaknesses, opportunities and threats for sustainability (see Table 3 for the indicators at territorial and farming system levels). A major output here is understanding what SARD means to local stakeholders, at least getting agreement on SARD goals and indicators, and accordingly diagnosing their farming systems in the study areas and the capacity for achieving such goals.

Step 4 Analysis of long-term evolution of farming systems. The step consists of identifying long-term trends (50-60 years) that affect the local area, then identifying the causes and driving forces of these trends in order to understand the endogenous and

exogenous factors influencing the long term evolution of the farming systems. The analysis of the linkages and the positive or negative effects of the external on the internal driving forces is performed by the stakeholders. Based on an understanding of the interplay of these factors, participants then draw up two scenarios for the medium-term future. One scenario assumes "business-as-usual", where the long-term trends continue; the other is an "optimistic" scenario: a plausible alternative that is closer to the development goals that people identified earlier.

Step 5 Identification of policy priorities and development of an action plan. This step identifies potential policy changes, involves identifying strategic and specific objectives, then drawing up a list of policy measures that will help achieve these objectives. These proposed measures are then assessed against what ongoing programmes or projects are doing, what the gaps are, and then they are prioritized and allocated to different government units and other development agencies. The results of the policy development process are then checked back with the local stakeholders to make sure that they are valid, and submitted to national-level decision makers for approval and implementation. This step also assesses whether the policy/institutional and methodological recommendations, synthesized from all case studies, can be adopted, adapted and implemented in a cost-effective manner in each country.

The participation of the different stakeholders was quite dynamic and intense throughout this step-wise process. For example, Honduras had 2 meetings of the national coordinating committees involving 19 participants, 5 local meetings with some 209 participants, 3 inter-municipal meetings with 57 participants, and 3 national meetings with 76 participants.

Main Results and Recommendations

Each case study considered some five key policy objectives, each objective requiring multiple policy interventions or measures, and requiring specific actions and resources to implement them. Though there is variation across case study recommendations, here is a brief synthesis of the priority policy issues and needs:

- Provision of a strong political-administrative boost and advocacy for SARD, e.g. raising the national priority of agriculture and rural development and the appreciation of farmers and professionals who work in the sector.

- Need for more favorable macro policies for agriculture and rural development, e.g. interest rates, investment and agricultural prices, and policies on physical and service infrastructure that is essential for smallholders to produce efficiently and competitively.

- Trade and market linkages, access and stability, e.g. concerns about imminent trade agreements, capacity to meet food and safety standards, price stabilization and farmer-market linkages.

- Decentralization of skills and resources to match the devolution of authority and responsibilities to regional and local authorities and stakeholders, as well as need for effective mechanisms to access public support.

- Governance and people's participation, e.g. rural people not having political voice, especially for women, youth and landless, and concerns about institutional responsiveness and accountability.

- Strengthening of rural communities, farmer organizations, cooperatives and associations, e.g. need for entrepreneurship, economies of scale for key services, business management and accountability.

- Support for research, extension and farmer training, e.g. focus on the agri-food value chain, integrated productive and ecological objectives, and how the public, civil society and private sectors should work together.

- Accessible and affordable financing schemes e.g. need for appropriate instruments for rural finance, pooling risk, reducing the cost of intermediaries, and managing remittances.

- Improvement of farming systems productivity, e.g. water access and management, soil fertility management, high value commodities and income diversification out of agriculture, e.g. value adding, rural tourism and linkages, environmental services, etc.

Territorial or District level	Farming system or local level
Environmental	

● % arable land with severe soil erosion • Soil fertility level • % land with forest cover: 30 yrs ago & now • % area protected for biodiversity • % human population with access to water sources • Presence of water-borne diseases • % total agricultural land under irrigation	• Soil erosion rate • Soil fertility level ● No. species or varieties/ ha used in crop & livestock ● Kg/ha/year chemical fertilizers used ● Kg/ha/year pesticide used • Kg/ha/year organic fertilizers used • % agricultural land under irrigation
Social	
• Net enrolment ratio in primary school • % adult literacy rate ● % households with access to potable water • Infant mortality rate • Under 5 years mortality rate • % underweight children under 5 years age • % population under minimum dietary energy consumption • % below poverty line (< US$ 1/day) • Ratio girls/boys in primary & secondary education ● No./% women at higher level of district level organizations • % rural population ● Population density, persons/km^2 • Population growth rate • Incidence of crime	• Net enrolment ratio in primary school • % adult literacy ● % households with access to potable water (source) • Infant mortality rate • Under 5 years mortality rate • Proportion of children < 1 year immunized against measles • Prevalence of HIV/AIDS, malaria & TB • Ratio girls/boys in primary & secondary education ● No./ % women at higher level in local organizations • % below poverty line (< US$ 1/day) • % households with secure land tenure • % landless households • Prevalence of larceny & illegal activity
Economic	
• Production & value of major agricultural commodities • % employed in agriculture, industry, services • Yield/ha of major agricultural commodities • Value of export products, $/capita ● Public budget for local government, $/capita • Km of paved & non-paved road • Value of remittances from migrants ● No./value of external donor & cooperative projects in production • Telephone lines or cell phone subscribers per 100 persons • Personal computers in use per 100 persons	• Average farm size per household (ha) ● % households by main sources of livelihood • Average household income per source • % on-farm household income • % farm production consumed at household level • % farmers who use formal credit • Estimated cost of credit: interest & admin charges • Value & composition of exports • % households with telephone lines or cell phones • % households with personal computers • No./type of assistance projects in productive sectors
Cultural	
• Existence of government policy & laws that promote & protect local cultures, cultural industries & indigenous people • Programmes to improve institutions that preserve cultural heritage, teach indigenous languages or develop cultural industries • Business industries or associations that work with cultural/indigenous services, handicrafts, foods • % ethnic composition of total population	• Occurrence of important cultural, religious or indigenous people festivals, shows and such activities • Economic importance of cultural tourism, handicraft, foods, or other • Existence of conflicts or other issues with indigenous minorities • % ethnic composition of total population • Harmony and unity of households
Institutional	

• Existence of sustainable development strategy of district • Planning capacity of district or municipal government • Public budget on basic services (health, education, sanitation, etc), $/capita • Expenditure on R&D, extension and training, $/capita • No./value of external donor & cooperative projects for institutional strengthening	• No. associations/unions of farmers, producers or workers • No. health clinics or medical centres • No. agricultural colleges (secondary) • No. adult training and literacy centres • No./type of savings or credit organizations • No./type of external donor & cooperative projects for institutional strengthening

The project also sponsored a workshop in each region to critically analyze the methodology and recommendations of the case study and to identify SARD-relevant priorities for future regional collaboration. Approximately 40 senior professionals, practitioners and local stakeholders participated in each workshop, representing the host country, other countries from the region, donor agencies and FAO staff. Table 4 presents a list of the countries and agencies, other than those of the host country, and the main recommendations of each regional workshop on methodology and outputs of the case studies and the priority themes for regional collaboration on SARD.

An important concern of the regional workshops related to how to disseminate the project results so they lead to action. For example, policy makers and government parliamentarians need to be made more aware of the urgency of agriculture and rural development for poverty reduction, MDGs and national economic development, and concrete proposals for budget allocation should be made to them. The best means for doing so are through direct dialogue, international consultants (they trust consultants), information kits, policy briefs, policy makers participating in SARD workshops and farmer organizations putting pressure on them. To implement pro-SARD methods and strategies, they recommended developing real partnerships, results-oriented alliances and networking that involves local farmer organizations, local government units, government departments, NGOs, research institutes and the private business sector.

Table 4 Main results of regional workshops in Latin America, South Asia and West Africa

Criteria	**Honduras** (13-15 July 2004)	**Mali** (26-28 October 2004)	**Philippines** (19-21 July 2004)
Participant countries & agencies	Guatemala, El Salvador, Nicaragua, Colombia and Venezuela, CIAT, GTZ & EU	Benin, Burkina Faso, Mauritania, Niger, Chad, Togo, French Embassy & Sahel Institute	Cambodia, China, India, Indonesia, Laos, Nepal, Pakistan, Sri Lanka, Thailand, IRRI, ICRISAT, JANIC-Japan, World Rural Forum & SEARICE
Strengths of Methodology	Strong on mobilizing &empowering stakeholders to effectively influence SARD policies and programs. Analysis of SARD goal follows a holistic, integral & dynamic process An effective & continuous participation of local, municipal, national & international stakeholders	Participatory approach particularly appreciated by Sikasso stakeholders & participants of other countries Bottom-up approach articulates priorities well at local, regional & national levels Temporal analysis integrating diagnosis of SARD situation, analysis of past & future scenarios	Good multidisciplinary capabilities employed in Project Coordination Committee & research team, and gender balance in research team Good response from local stakeholders in diagnostic & future scenario analyses Very good documentation on FSs, gender & youth roles, NRM & emphasis on culture & other issues for SARD

Suggested Improvements	Ground/ prioritize & transform SARD's multiple, diverse components & interventions, into action and being realistic about context & capacities of local stakeholders. Need more knowledge on stakeholders, i.e. historical background, values, needs, incentives, knowledge, asymmetries, to harmonize strategies Territorial approach as possible effective framework to refine, replicate & apply project's methodologies & recommendations	Strengthen gender approach and involve women organizations Design precise TORs to better manage multi-sectoral & multi-institutional team Improve communication on project when implementing case study & disseminating its outputs to involve and get support of all stakeholders Emphasis on lessons learnt as part of project's methodology.	More flexible approach for better fit of methodology with local culture & bottom-up assessment from start More participation of Rice Research Institute Clearer focus on enhancing role of women and how to motivate youth to return to agriculture More holistic descriptions of FS/ community interactions Define SARD in total context of rural development, not only agriculture.
Pro-SARD policy and institutional strategies	Develop alternatives that build on traditional & modern technologies for efficient use of water, sloping lands & other resources Diversify components of FS & add value to primary products by vertical integration in food chain Recommend payments & incentives to farmers for environ services Strengthen entrepreneurial & financial capacity of FS stakeholders Guide & insert FSs more effectively in national & int'l econ & marketing processes Explore all ways & means to reduce vulnerability to natural, economic & social risks Need continuous support & collaboration from public, private & techn cooperation agencies	Give value to agriculture & agric professions, e.g. design a particular statute for farmers; design & implement financial safety net for natural disaster Implement existing legislation on decentralization, e.g. strengthen capacity of public, private and NGO support services; & implement M&E policies Design & implement policy & measures of restoration & protection of productive ecosystem, e.g. contracting of research & its funding; design & implement national & decentralized policies for ecosystem & NRM Mobilize funding, technical & human resources, to strengthen capacity of public sector and local stakeholders	Focus on mixed cropping, organic farming, past crop improvement, community-developed seeds, appropriate irrigation facilities and water sources, & farmers' access to seeds, land and water. Explore ways of increasing investment for small farmers & for sust. agriculture Develop viable marketing systems and village-level processing enterprises Professionalize government in external relations for building effective trade-marketing linkages Provide strong financial support to local people orgs., e.g. cooperatives, enterprise development, horizontal linkages Link farmer extension & education with local government plans & programmes (e.g. Farm Science Center of India), & gender-sensitive approaches to expand livelihood opportunities for women

Priority Themes for Regional Collaboration	Strengthening sustainable production systems, e.g. technology generation, GMO policies, service provision, roles of public & private sector, & replication & up-scaling of success "stories" Territoriality, institutional development & participation strategies for SARD, i.e. integrated land use planning, decentralization strategies, & capacity building Training municipal & local stakeholders, for policy formulation, sustainable FS management, enterprise development, & curricular development for SARD Exchange of experiences on pro-SARD strategic topics, i.e. policies, institutions, partnerships & alliances, stakeholder & community participation	Promoting sustainable management of natural resources, e.g. strengthen management capacity of grassroots people; design & implement policies for NRM by grassroots people Strengthening capacity and competences, e.g. implement regional framework for concerted action of concerned stakeholders; design of relevant legislations Promotion of SARD regional partnerships and regional network, e.g. nominate regional coordinator & national focal points; develop resource facility on SARD-related strategies, laws & regulations, and disseminate project/case study outputs and lessons learnt	Land reform & resource rights to make SARD a people-centered process, i.e. rally public opinion for more equitable resource distribution, halt corporate sector gaining more control of resources, & making land reform a priority. Rural enterprises & markets, i.e. understanding of market forces, building market links & negotiating capacity of farmers, enterprises for diversification, support services & infrastructure, & social marketing of SARD itself Capacity building on GAP, e.g. integrated NRM, diversified & integrated FS, training & comm. materials, & effective communication of SARD policy Solidarity network & info exchange, to build partnership & advocacy for SARD among NGO/GO/private sector, UN & donors, & strengthen regional & local capacity

NB: FS farming systems; GAP good agricultural practices; GMO genetically modified organisms; GO government organizations; M&E monitoring and evaluation; NGO non-governmental organizations; NRM natural resource management;

Lessons learnt from SARD-FSE

The SARD-FSE case studies offer a few salient lessons on the methodology, which are summarized as:

1. Alternating the venues of the global team meetings among countries permitted involving the national teams and other stakeholders in each country, and enabled the team leaders to gain a first-hand appreciation of the similarities and differences among the selected farming systems and institutional contexts.

2. The selection of case study farming systems and territories should not be driven by external considerations (the global context was used to identify systems and countries) nor by national political considerations (which was necessary to attract the interest of national authorities to participate). The selection of both should be based on how well they represent the country in terms of its agro-ecological and socio-economic conditions. The latter enhances the importance and attention given to the study by national stakeholders.

3. On the SARD indicators, secondary data at the national level are available, not so for secondary data at the territorial and local levels. The teams appreciate the value and the usefulness of the range of indicators recommended for each pillar SARD; however, each country has to adapt them to their specific systems under study.

4. The farming systems and territorial frameworks are relevant and effective for policy and institutional analysis. However, more exposure and time is required to ensure

stakeholders are more informed to enable better analysis of their systems and policy needs. The territorial framework was found to be the more appropriate level (compared to the local and national) to understand local society, municipal issues and technology variables, to analyze scenarios, stakeholder issues and political factors and to make recommendations on institutional collaboration and programmes.

5. The analysis of the long-term past trends was found to be effective for analyzing changes related to climate, land tenure, diversification, infrastructure and education. Good information was generated on these issues, and particularly on understanding the links between institutional change and farming system development. The analysis of influencing factors was important for establishing effective sharing and for integrated understanding among stakeholders, which was essential for the analysis of future scenarios and recommendations. Some results of stakeholders' workshops (recall discussions) were not supported by empirical data.

6. Future scenario analysis is stakeholder-friendly. They engendered excellent interaction from stakeholders and enabled them to reflect, independently and as a team, on their own concerns, interests and recommendations, and they came up with quite similar results and conclusions. The exercise was particularly useful in terms of focusing on constraints to achieving the optimistic SARD-oriented scenario. Some farmers found it difficult to think many years in advance, and for some specialized technicians, to think in a more integral and futurist manner.

7. In terms of promoting local ownership and building towards sustainable solutions, it is essential that international donors, NGOs, programmes and projects, as well as financial, technical, governmental and private institutions, work together and closer with the local stakeholders in order to plan their development strategies, identify policy actions and implement programs that can respond to their own development needs, potentials and aspirations.

The SARD-FSE methodology shows high potential and advantages from the perspectives of local stakeholders:

1. It certainly empowers local stakeholders for meaningful participation on issues of real concern to them, such as what policies and institutions should do for them, how to increase agricultural productivity and food security, how to boost economic activities, jobs and income or protect the local environment. It is cost-effective for participation and communication among local stakeholders, marginalized groups, national policy makers and donors in planning local development initiatives.
2. It can improve monitoring and evaluation of policies and programs through the use of local indicators reflecting the real situation. Local decision makers and stakeholders can more easily report on critical issues to national decision makers and other stakeholders, including on macro-level issues such as commodity prices, infrastructure investment, and trade and marketing policies.
3. It promotes the effective mobilization and use of resources for local development through better coordination, less duplication of efforts and higher pay-off of externally supported programmes.

4. It promotes participatory democratic processes that can pave the way for enhanced social cohesion and equity, and consequently more peace and prosperity in rural areas.

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Public-Private Partnerships: A Promising Approach for International Agricultural Development or One's Worst Nightmare

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Abstract

This paper provides a summary of key characteristics associated with successful partnerships and then employs a recent case study to illustrate and discuss some of the strengths and weaknesses of public and private partnerships as instruments for international agricultural development. Particular attention is paid to the challenges of combining the resources of different stakeholders who often have different motivations, values and understanding of the development process. The case study focuses on a recent attempt to bring together a public university, two bilateral donor agencies, an international NGO and a private sector small business firm in the delivery of overseas technical assistance and training.

Introduction

It seems that the term "partnership" has become the latest word in the development community. Like its predecessors, Integrated Rural Development (IRD) in the 70s, Farming Systems Research (FSR) and Rapid Rural Appraisal (RRA) in the 80s and Participatory Rural Appraisal (PRA) and Participatory Action Research (PAR) in the 90s, the term "partnership" has been over-used, misunderstood and sometimes even abused. One often sees partnerships in name but not in action. In the eyes of the donor partnerships are often seen as a way to leverage resources. Joining forces with other agencies or organizations is a way to generate impact from foreign assistance budgets. For many donors such partnerships have taken the form of collaborative contracts and grants with non-governmental agencies (NGOs) that are willing to match some of the donor's funds with their own financial resources and human capital or between public schools and private community groups in support of local education.

Most of the public-private partnerships in agriculture development have involved linkages between publicly supported agricultural research centers and major multinational corporations involved in different aspects of crop improvement. One such example noted recently in an International Food Policy Research Center (IPFRI) report is the case where two European researchers based at the Swiss Federal Institute of Technology and the University of Freiburg developed the technology that enabled them to produce lines of rice with high amounts of beta carotene to alleviate vitamin A deficiency among the worlds's poor. The two scientists then partnered with a private biotechnology firm for the further development, testing, and commercial release of "golden rice."(Fritschel, 2005). Such partnerships have more recently been expanded to include linkages with the corporate business community where the emphasis is more market expansion of existing crops than on the creation of new technologies or genetic organisms.

Major donor organizations such as the World Bank (WB), the Asian Development Bank (ADB), the U.S. Agency for International Development (USAID), the German Development Agency (GTZ) and the British Department for International Development (DFID) all have

policies that recognize the importance of harnessing corporate resources in the battle to reduce poverty, increase agricultural production, improve human health and provide better educational opportunities to the developing countries of the world. In a recent survey conducted by the World Economic Forum's Global Corporate Citizenship Initiative (GCCI) nine out of ten CEOs felt that partnerships between business, government and civil society must play a role in addressing key development challenges facing the world (World Economic Forum, 2005). In reality, such partnerships are easy to talk about but very difficult to achieve. The GCCI report suggests that although such public-private partnerships are new and untested they have the potential to drive innovation and raise the standard of living of millions of people. However, in the area of agricultural development there are few examples of public-private partnerships where the expected benefits have actually been achieved (IFPRI, 2004).

Background

The concept of partnerships in development builds closely upon the increasing attention being paid to the participation of clients or beneficiaries in the design, implementation and evaluation of development projects. True partnerships generally involve a process of good faith negotiation wherein the different partners may have to give up some portion of their own power and agendas. As will be seen in the case study that will be described later on this can often be a very difficult process for both donors as well as the other implementing partners in a partnership for development.

The growing literature on participatory development (Biggs, 1989; Pretty, 1994; Mikkelsen, 1995; and Ashby, 1996) often refers to a hierarchy of types or levels of participation including the following.

> *Contractual participation* – where one stakeholder contracts for the services of another. A common example of a contractual partnership is where a group of researchers pays rent and hires the services of one or more farmers to carry out an on-farm trial under their supervision.
>
> *Consultative participation*– where one stakeholder group controls decisions and seeks to gather information from other stakeholders. Sondeo (Hildebrand, 1982) and Rapid Rural Appraisal (Jamieson, 1987; Grandstaff & Messerschmidt, 1995) where a team of researchers interviews and collects information from farmers is a common form of consultative participation.
>
> *Collaborative participation*. – where different stakeholders are brought together on a more or less even footing. In a collaborative arrangement the partners acknowledge their respective contributions and responsibilities and share decision-making power in project implementation
>
> *Collegial participation* – where different stakeholders work together as colleagues. Ownership and responsibility are equally shared among partners and decisions are made by agreement or consensus. (Adapted from Probst and Hagmann, et al., 2003).

Partnership where there is truly equal sharing in the design, implementation, evaluation and benefits of research program or a development project is the ideal. However, most of us who

have attempted to design working relationships with overseas research institutions and government agencies know this kind of partnership is rarely achieved. In reality, when the rhetoric and platitudes are set aside, one is generally faced with the challenge of trying to make the best of what are inherently unequal relationships. One partner nearly always has more funds, more resources and/ or greater ownership of the process than the other stakeholders. In such cases each partner must be willing to acknowledge and respect the differing contributions and roles of the other partner(s).

Following on the different types of participation identified by Pretty and others, Gelia Castillo (1966) identified five types of international research relationships in a report entitled "Research partnerships: Who Pays and Who Benefits." She suggests that most partnerships between universities in the North and research centers in the South can be categorized into one or more of the following types:

> *Partnerships of convenience* – where partners in the South function simply to legitimize researchers from elsewhere entering the country.
>
> *Contractual partnerships* – where partners from the South gather the data while interested parties in the North pay for the services and own the data.
>
> *Uneven partnerships* – where the North proposes the project, develops the procedure and finds the funds and the South implements the research.
>
> *Reluctant partnerships* – where the main preoccupation of each party is how to take advantage of resources available from the other side.
>
> *Patronage partnerships* – where the Southern Partner is assigned the role of a minor associate and has to endure paternalism and continuous advice from the Northern partner.

The Castillo paper focused on research partnerships but many of the issues raised are relevant to more practical partnership arrangements focused on the design and implementation of technical assistance and training activities. To build a true partnership, the partners must be willing and able to define and communicate their goals, interests, needs and mutual benefits as the firs step towards building a shared vision. They have to be able to work out common and compatible strategies and to progressively build trust. A recent report of the Swiss Commission for Research Partnership with Developing Countries (KFPE, 2003) identified 11 Principles of Research Partnership:

- Decide on the objectives together
- Build up mutual trust
- Share information
- Share responsibility
- Create transparency
- Monitor and evaluate collaboration
- Disseminate the results
- Apply the results

- Share profits equitably
- Increase research capacity
- Build on achievements

It is clearly difficult to achieve collaborative or collegial partnerships between two universities or research institutions that are assumed to share similar values with respect to the research and the role of scientists. Imagine the challenges when one attempts to bring together university researchers with bilateral or multilateral donors, private humanitarian relief and assistance groups and private sector firms a s\partners in an integrated development project.

The following case illustrates how the challenges of brining together the unique resources and capabilities of such diverse groups to implement a partnership based on a common agenda and mutual benefit can become a nightmare.

Case Study

"The term "Public-Private Partnership" covers a wide variety of interactions including university-industry research projects, multi-party and multi-sectoral research consortia, local development programs between small business and government, or large-scale global partnership programs."(IFPRI, 2004). The following case focuses on an effort to craft a partnership involving a small business enterprise, an NGO, an educational institution and two bilateral donor agencies.

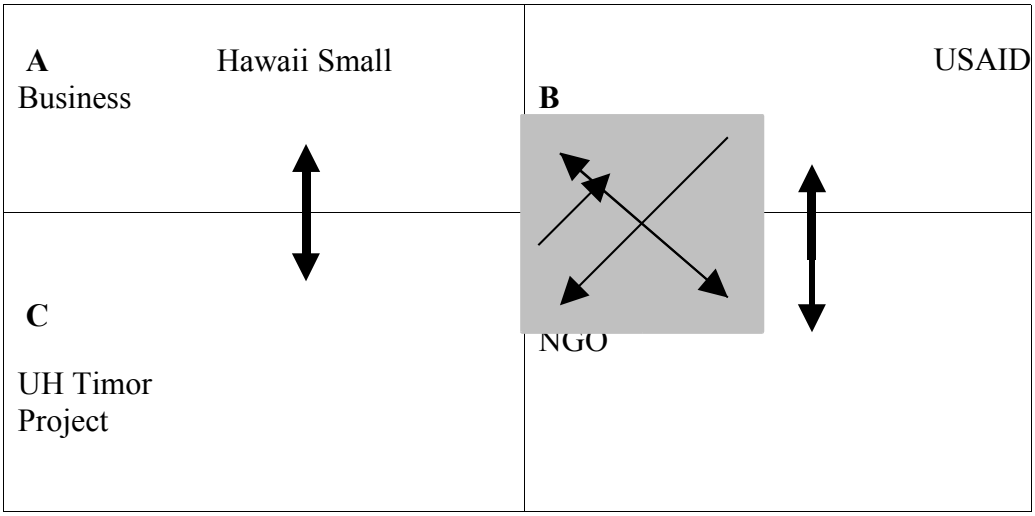
The University of Hawaii is currently managing an agricultural rehabilitation, income generation and natural resource management project in East Timor with funding support from the U.S. Agency for International Development (USAID). While conducting on-farm trials for the improvement of maize and rice production in the Seical watershed our field staff became aware of the abundance of candlenut trees (*Aleurites moluccana*) or what is known in Hawaii as kukui. The nuts of this tree fall to the ground when mature and are collected by rural villagers to be sold to traders who eventually export the shelled kernels to Indonesia where the meat is used as a food condiment. Up to now the collection and shelling of candlenuts has provided a source of supplemental income for rural families. Farmers have no control over the market, which is totally determined by the price that buyers in Indonesia are willing to pay based on fluctuating supply and demand. Since East Timor's independence in 2000, the Indonesian Government leves an 11% tariff on nuts coming from East Timor making them more expensive to the consumer that those grown in Indonesia. When the price traders are willing to pay East Timor farmers drops below about 35 cents per kilogram for shelled nuts, people simply choose not to sell their nuts.

When the project staff in Hawaii shared this information with a small firm in Hawaii that refines and markets candlenut oil as "kukui nut" oil for the cosmetic and skin-care industry an idea was born about the possibility of setting up a candlenut oil extraction operation in East Timor for export to Hawaii. This idea was consistent with the income generation objective of the USAID project and also drew positive attention because of its potential impact on rural women. The local firm initially saw an opportunity to firm up its supply line for crude candlenut oil that would enable it to expand its business while being a good corporate citizen. They saw an opportunity to grow their business while investing in the

people of East Timor. As the donor agency, USAID also saw the possibility of developing this concept in a proposal for its Global Development Alliance program whereby the agency seeks to partner with corporate industry in the delivery of overseas development programs. The agency has partnered with the Nestle Corp. in the expansion of the cocoa industry in Indonesia and helped the East Timor coffee cooperative to develop an arrangement to sell the bulk of its premium coffee crop to Starbucks.

USAID felt that developing a candlenut oil operation in East Timor could also provide an opportunity for one of the NGOs (non-governmental agencies) with which it was already working to organize rural women's cooperatives in support of a community owned and operated business. At this point the idea was consistent with the objectives of the donor agency, the university project, the private sector firm and the NGO. Figure 1 identifies the four key actors in the proposed partnership and indicates that initially communications lines were stronger between actors A and C and B and D. This unintended dynamic resulted in the formation of two opposing alliances with actor C supporting the position of A, and B supporting the position of D in the disagreements between A and D. The circle in the middle of the diagram represents the area of initial of common understanding with respect to the general goals of the partnership

Figure 1.
Initial four-way public-private partnership



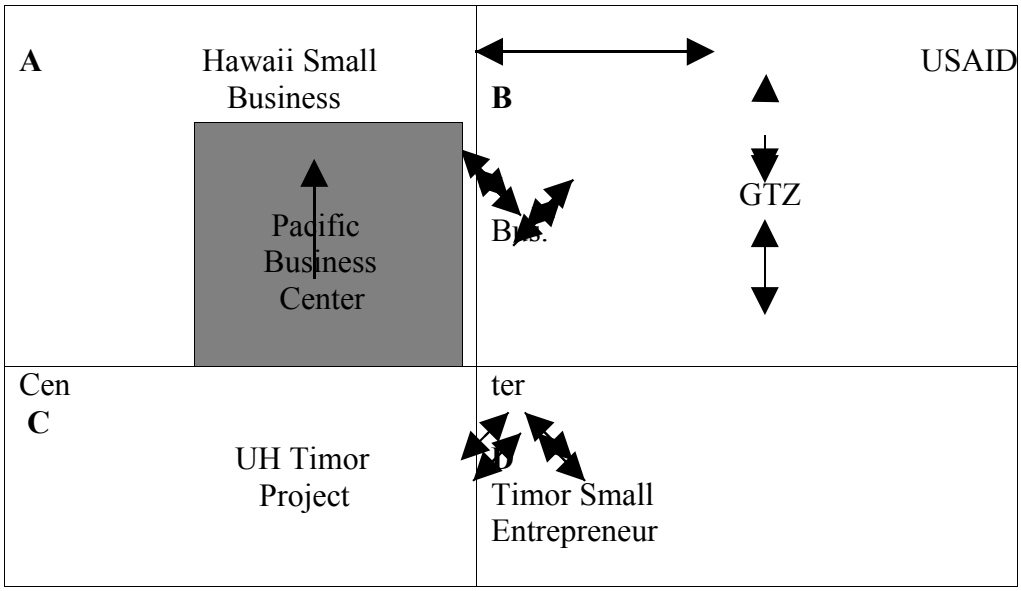
The potential stakeholders collaborated on the design for an economic feasibility study that was quickly supported by the donor agency through a small mission-level grant to the NGO. Each of the stakeholders were represented on the team that conducted the study and all came together for a three-day meeting in Hawaii that was supposed to set the base for the development of a larger USAID supported Global Development Alliance (GDA) proposal. It was at this point that the complementary objectives of the different actors began to be overshadowed by their emerging differences in terms of organizational needs and operating style and the threads of true partnership began to unravel. As one participant in the meeting noted, "the devil is in the details."

The first obstacles that had to be overcome was the obvious different needs of the for-profit small firm that was interested in growing its business and the NGO that wanted to expand its externally-supported community development operations in East Timor. The for-profit motive that was a philosophical problem for the NGO was further complicated by the fact that the small business was proposing to be the exclusive buyer of the oil produced by the plant to be established in East Timor. The NGO saw this as a monopolistic operation that they could not support. The small business operator, on the other hand, perceived this as a rational way of maintaining his position in a very small niche market for refined kukui oil. The other main point of contention that quickly emerged was over control of the operation. The NGO felt that since it had the most in-country experience as well as a local staff that it should receive the GDA grant and be in charge of the entire operation. This was unacceptable to the small firm that was going to provide the equipment and the technical support for the oil extraction operation. The NGO had a hidden notion of kind of community ownership they wanted to foster but this was never defined and openly discussed.

Looking back at the 11 principles of partnerships identified by the Swiss commission it appears that while the stakeholders in this case were able to agree on the general objective of the project they were unable to reach a level of mutual trust that would have enabled them to agree on a process of sharing information and responsibility. The duplicitous attitude of each actor was clearly visible to the outside observer at the initial meeting but apparently was not evident to the actors themselves. Everyone felt that they were operating according to the loftiest of motives.[i] After nearly six months of trying to reconcile the differences between the small firm and the NGO the stakeholders concluded that the differences were so fundamental that they could not work together. The CEO of the small Hawaii business lost faith in the NGO and its country director in turn was unwilling to comprise or negotiate a middle ground position with the university and the private firm with respect to management and ownership of the project.

In the end, a unit outside the university's existing project that has experience mentoring small-scale business operations in the American Pacific was brought in to facilitate a new relationship between the small business owner and two bilateral donor agencies, USAID and the German GTZ to support a local East Timor entrepreneur to become manager of the new candle nut oil extraction operation. Figure 2 illustrates the dynamics and communication flows between the key actors in the second partnership structure. In this model there is equal communication flow between the actors. Particularly noteworthy is the direct communication between the two donors groups in box B. In the second model the Pacific Business Center played a crucial role in helping to foster communication between the stakeholders and in developing a business plan and an advance purchase agreement from A that has enabled D to apply for a commercial bank loan to cover the costs of his investment in the new enterprise. Rather than a true joint venture arrangement what has evolved more of a business arrangement between A and D that is supported by the public sector stakeholders B and C to ensure that the arrangement now only meets the needs of the two business entities but also achieves the intended development goals. The center square has darker shading than Figure 1 indicating that in the second partnership model the areas of common understanding with respect to objectives, management and process are much stronger among the partners.

Figure 2
New Partnership Proposal Involving Five Stakeholders



The creation of this partnership required the development of a solid business plan, convincing the Hawaii businessman that his East Timor partner was reliable and could be trusted and working out several philosophical difference between how the donor donors approach small business development. Based on lessons learned from the first experience the second effort was grounded on greater trust among the stakeholders and a clear understanding of the incentives of the two business partners. Also, every effort was made to minimize the bureaucratic procedures often associated with the public sector funding and approval processes.

Conclusion

Based on our limited experience with several research international research partnerships and the reported case study it is clear that generating workable partnerships between two academic/research organizations or between two business entities is much easier than crafting such relationships between public and private organizations and between profit and non-profit entities. In the business community, for example, money acts as the common denominator in which all of the disparate interests of the participating partners are expresses, measured and reconciled.

It may be more difficult to identify a common denomination in which to express and reconcile differences in the non-monetary values, goals and missions of academic institutions, development agencies and non-governmental organizations. This was clearly the situation in the East Timor case. Unbeknown to the stakeholders in the original proposed partnership there were some clear differences in individual needs and expectations that could not be met by the original framework. Unfortunately, the dynamics of the initial discussions and the lack of trust that emerged between the private firm and the NGO made it impossible

for this information to be shared in a way that the differing needs might have been resolved. It was initially felt that all that was necessary was to generate acceptable compromise between the different actors. In hindsight the key factor that needed to be focused on was establishing trust among all players. Rather than being able to deal with the different agendas upfront the dynamics were such that two informal coalitions emerged with the university supporting the private firm and USAID aligning with the NGO. This led to a kind of stalemate in which no further movement was possible.

Another observation and lesson that can be discerned is that the private sector, and particularly the business community, has much less tolerance for government bureaucracy than do universities and other public institutions. In the case of the Timor partnership, the GDA approach was abandoned because it involved far more levels of donor assessment and approval that the small business partner was willing to tolerate. In the end, the current arrangement is primarily between the Hawaii business and the Timorese entrepreneur. The two donors and the Pacific Business Center are primarily serving as supporting institutions to ensure that not only do the private firms generate their needed return but that the partnership also achieves its stated development objectives.

Based on the experiences of this case and others reported in the literature the following guidelines are offered to those interested in pursing the potential of public-private partnerships a means to achieve specific development objectives:

- Build trust among all the stakeholders. This is often difficult to do when the actors are not always forthcoming about their real needs and concerns.
- Keep it small and manageable. Increasing the number of stakeholders in a partnership increases the potential for conflicts that may undermine the ability of the groups to achieve its stated objectives.
- Before finalizing a formal partnership reach agreement on what each partner is willing to contribute and what each expects to get out of the relationship.
- Recognize that while people may easily agree on the public objective of the partnership that vested interests and hidden agendas may undermine the ability of the partners to negotiate workable agreements related to over-all management, division of responsibility and allocation of resources.
- Maintain clear and open lines of communication. When dialog and sharing of information diminishes so does the relationship.

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The Role of Cooperatives in Improving Quality of Life and Providing Sustainable Development

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Abstract:

The aim of this paper is to present a comparative analysis about two agricultural cooperatives in Brazil, in order to better understand the social role of cooperativism in improving quality of life and providing sustainable development. Farmers and consumers may benefit from services offered by cooperatives, everywhere in the world. Nevertheless, they will not provide good quality services if people do not know enough about them and their main principles. There are many studies about this kind of organisation, even in Brazil. However, very few Brazilian people are engaged in a cooperative. This study shows that many people do not know enough about the advantages of getting enrolled in this kind of organisation and the role of cooperativism in improving trade and the quality of life in local regions. Cooperatives exist for people in difficulties and people with cooperative spirit. It is because mutual aid and reciprocity among partners are basic principles for the proper development of members, thus contributing to have a world more just and balanced. Moreover, lack of appropriated communication among members, committee members, their families and consumers is also another big issue in dealing with this issue. In this context, one of the roles of training in rural areas should be related to optimising the relationship among actors directly or indirectly involved with cooperativism and preparing

members to manage properly their own cooperatives and keep, at the same time, an eye on the social aspects of life that may be strengthened by cooperative movement and by social responsibility of other private companies. It will empower small farmers to influence policy making and institutional reforms for livelihoods and quality of life of the rural people leading the region to sustainable development.

Introduction

In the current world, people are living deeply inside of intense changes. The global competition that stresses the differences between and inside countries, increasing the number of social and economical exclusions is determining the revision of productive and commercial processes transforming competitiveness into a permanent question. Even cooperatives are inserted in the context of global economy and they need to improve their activities in order to survive and help other to survive too.

How to face and win the great challenge of managing cooperatives everywhere, acting competitively in the market and internally creating a economic and cultural space for cooperation, taking care of members that are themselves the owners of the business? Cooperatives are based on their doctrinal vision, capable to harmonise the economic with the social aspects. It is supposed to combine capital and work so that members are investors who capitalise their own companies. On the other hand, the capital should operate as an auxiliary function, to serve the economic and professional activities of the member and local community (Duarte, 1985; Schneider, 1999; Pinho, 1966; and Schneider 1992).

Members should believe in the ethical values of honesty, transparency, social responsibility and be concerned about the other people business in order to improve their cooperative movements. The values and principles must be incorporated in the enterprise operations of cooperatives. In this context, this article aims to present a general overview about Brazil, some general data on cooperativism in Brazil and present a comparative analysis about two new agricultural cooperatives from the South of Brazil. It is because cooperatives should be an excellent mean to promote socio-economic development of members, facilitate trade and market linkages, empower small farmers to influence policy making and improve livelihoods and quality of life of rural people. Therefore, they help to reach sustainable development for local communities. Despite that, many people involved with cooperative movement do not know enough about all variables directly or indirectly involved on it and in this case education and training must play an important role in optimising the relationship between the actors involved in this movement.

Theoretical Review

Since the beginning of humanity men had appealed to an associative form in intention to brighten up the fight for survival and to provide a better life for themselves and their families. Cooperation represents indeed more than a simple addition of human beings, therefore it is a creative synthesis of that something better happens when its elements work together. Despite of that, many people rather work by themselves instead of helping each other to reach their goals together. In this context, cooperative movement plays an important social role that should be better discussed and understood by people interested in sustainable development and social responsibility.

Cooperativism in Brazil

In Brazil, the cooperation in itself is recognised since the previous time of the country discovery, through the aboriginal collective systems. It gains a great contribution with the "Republic of the Guaranis" associative experience promoted by the Jesuit priests, after the arrival of the Portuguese in our nation. But, as Irion (1997) states, only with the arrival of the European immigrants, mainly from Germany and Italy who introduced the first modern cooperative ideas that it was formed the first cooperative.

Since that time, some attempts for the adoption of cooperativism in Brazil had occurred and the first one was launched in 1847, in the State of Paraná, and the second one in the State of Pernambuco. On January 5th, 1907, the Decree Number 1637 was in fact the first step for the normalization of the Cooperativism in Brazil. However, the most important law appeared later within the Decree Number 22.239, December 19th, 1932 that consisted in a real cooperativist statute. On August 19th, 1938 it was reformulated by the Decree-law 581, and it had been added to the existing Legislation. Finally, on December 16th, 1971 the Law 5.764 was edited and promulgated. It is since that time, what was known as "the Law of the Cooperatives", it defined the National Politics of Cooperativism instituting the legal statute of the cooperative societies and giving other steps.

According to ACI (2003), there were 10.412 cooperatives in Latin America, in 2002. They are distributed as shown in Table 1. It is possible to observe that Brazil is in the lead with nearly three quarters of this total.

Table 1: Number of cooperatives in Latin America, 2002

Country	Number of Cooperatives	Country	Number of cooperatives
Brazil	7.549	Paraguay	76
Colombia	1.936	Peru	71
Argentine	1.004	Chile	2
Uruguay	700	Bolivia	2
Equator	76	TOTAL	11.446

Source: ACI (2003)

ACI (2003) also presents the number of different kind of cooperatives within Brazil. The job cooperatives are in the lead with more than 2.000 cooperatives. Table 2 shows the accurate number of each kind, the number of members and the number of employees allocated in each kind of cooperatives in Brazil. Job cooperatives are in the lead with more than 2 thousand cooperatives, although they have only 311.856 members and 4.036 employees. Consumption cooperatives are in the lead according to their number of members, almost 2 million people are engaged in this kind of cooperative. It is relevant to observe that agribusiness cooperatives have the highest number of employees and almost 1 million members engaged in 1.626 cooperatives. Why the number of employees is too high? Is it related to the lack of managerial skill among the members of this cooperatives or is it related to the peculiarity of this kind of cooperative?

Table 2: Cooperatives in Brazil according to its kind, number of members and number of employees, 2002

Kind	Number of cooperatives	Number of members	Number of employees
Job cooperatives	2.109	311.856	4.036
Agribusiness	1.626	940.482	110.910
Credit	1.066	1.439.644	23.291
Health	878	261.871	23.267
Transport	698	48.552	2.099
Residential	313	104.908	2.472
Educational	303	98.970	2.874
Infra-structure	172	575.256	5.500
Consumption	158	1.920.311	7.219
Production	113	9.559	315
Mineral	34	48.830	35
Tourism and Laser	12	396	2
Special	7	2.083	6
TOTAL	**7.489**	**5.762.718**	**182.026**

Source: ACI (2003)

About 10% of these cooperatives are located on the state of Rio Grande do Sul. In 1999, it was registered in the Organisation of the Cooperatives of the State of Rio Grande do Sul, OCERGS, a total of 720 cooperatives (OCERGS, 1999). Since that time, more and more cooperatives are launched each month in the South of Brazil. As shown on Table 3, agribusiness cooperatives are in the lead of this rank with almost one third of this total. They are followed by credit cooperatives. In both cases, they also have the largest number of members. This reveals the relevancy of the cooperative movement in this Brazilian area. It is also worth to point out here that the South region is one of the most developed areas in Brazil, in many aspects such as economic, social and health. Cooperative movement seems to have helped a lot to reach this kind of sustainable development and improve the quality of life for people not only in rural areas, but also in urban areas.

Table 3: Cooperatives and number of members in the state of Rio Grande do Sul - Brazil, 1999.

Types	Number of cooperatives	Number of members	Types	Number of cooperatives	Number of Members
Consumption	43	20.000	Agribusiness	201	250.000
Credit	86	184.000	Telecom	18	180.000
Educational	11	2.500	Industry	2	300
Health	45	11.750	Residential	35	25.000
			TOTAL	720	725.050

Source: OCERGS (1999)

In order to know more about cooperativism in Brazil and in the State of Rio Grande do Sul look at Frantz (1984), Monserrat (1988), Fleury (1983), Basso (1993), Vilas Boas (2000), Souza (1995) and Polônio (1998).

Methodology

This paper is a result of exploratory case studies. Vergara (2000) defines research or exploratory inquiry as being that one carried through in an area in which it has little systemise knowledge. For its nature, it does not compare hypotheses, but it analyses assumptions that can be tested by comparing results of different cases. According to Yin (1994), this methodology of comparative case study is a particular type of participant research that assumes data-gathering more deeply. This kind of research possess an inquiry nature, because it has as main objective to take off conclusions and to serve of base for new studies, as also claims Yin (1994). The data was gathered mainly from questionnaires and interviews carried on with members and/or committee members of two different cooperatives, taking care so that the questions were directly related to the interested issue.

The respondents had been chosen inside regions where Cooperatives were acting. It allowed getting in touch mainly with small and medium size farmers and members of the board committees. In elapsing of the work the basic documentary analysis became necessary for getting a clearer interpretation of the economic and social objectives of the cooperatives. In the fieldwork it was searched for Social Statutes, the greater normative inside of a Cooperative, passing for Registry Books, where appear the Picture of Partners of the Cooperatives and finally the register of mercantile operations such as fiscal books, countable books and demonstrations, documents that evidence the economic indicative of the organisation. Such documentary research allowed the researchers to gather evidences about all registered operations of both Cooperatives. However, some actions directly related to social area had specifically demonstrated lack of registers in some cooperatives.

A historical analysis was performed in order to have an outline of the cooperatives since their foundation, focusing on actions and activities developed for the cooperatives in the social area, emphasising mainly the role of cooperative in dealing with sustainability of their own members. Such analysis got a more consistent support through interviews with members and committee members, where the spontaneous opinions of partners placed the experiences with their institutions since the beginning of their activities (Adler & Adler, 1987 and Ellen, 1984).

Agricultural Cooperatives in the South of Brazil

In order to have a better understanding about the two cooperatives analysed, it is presented below a brief summary about them. In the sequence, it is also presented the comparative analysis that shows the relevance of these cooperatives for improving the livelihoods and quality of life in local communities.

Cooperative of Milk Traders of Village Flowers Ltd – Coopflor Ltd

This Cooperative was established on May 30th, 1993 having as main activity milk caption to conduct the process of generating sub-products, such as, C type milk, cream and cheese. Nowadays, its social structure is composed by one hundred and forty members including small and medium size farmers. This cooperative emerged from the necessity of the agriculturists to have a better support to market their products, specially milk.

Coopflor Ltd, as it is known, acts mainly providing assistance and foment to its producers in order to provide technical structure focusing increases in production and quality. It works mainly in Bento Gonçalves region, Veranópolis and Nova Prata, where its main product nowadays is C type and long life milk. Coopflor Ltd is investing and preparing itself to enter in a new segment in the market, the one of milky drinks. Researches have revealed the local consumer has shown a good receptivity to the products. In the last three years, the income was pointed to a constant increase boosted by its investments in production improvements for its members, getting to an income around R$1.900.000.00 in 2000. It also ended up 2003 with the income reaching the amount of R$3.400.000.00 (Baldessera, 2003, p 45).

For an average company such income could represent a very attractive profit, but as to Coopflor Ltd such figures are not sufficient due to the fact the members are looking for better wages reducing the final profit to around 1 or 2 %. This kind of result shows that milk farmers get very low income, although they have high income.

Cooperative of Fruit Growers of Protásio Alves Ltd – Coopalves Ltd

Launched on August 20th, 2001 Coopalves Ltd concentrated its activities on fruit grow, especially apple and plum. Currently, its social structure is formed by twenty nine members, mainly small and medium size growers. They have the opportunity of selling their products to a big retailer located in the central region of the country. The farmers had congregated themselves to give legal form to this negotiation, since such retailer demanded specific documentation to turn them into a registered and structured company. So, they decided to create Coopalves Ltd to attend the necessity that such business demanded at that time. In the market of fruits, Coopalves Ltd sends the total of its production for the Southeast region of Brazil. The state of São Paulo is the main pick up point where Coopalves Ltd main contact has an office. The cooperative members are working to increase the variety of fruits produced, looking for a better use of the current cultivated areas, therefore it is possible to have two or more cultures in the same area. Thus, the members will not depend only on one or two crops. By doing it they decrease risks and losses in their production. The cooperative started effectively its operation in January of 2002 and presented an expressive evolution in the annual incoming. It moved mainly for the demand of its main product, apple. In the first fiscal year, its income was around R$900.000.00. In 2003, it reached almost R$1.500.000.00 (Baldessera, 2003, p 45).

Coopalves Ltd is a very new cooperative in the market thus it needs to invest in equipment and technical structure. This cooperative holds back a greater percentage of the value of commercialisation of its products for reinvesting in purchase of machinery and equipment to improve the production and gathering fruits grown by the members. Dealing with fruits, such segment offers more attractive edges of profitability due to high demand.

Coopalves Ltd closed two fiscal years with liquid profits between 15 and 18%. It is Coopalves politics to reinvest its dividends in the proper cooperative in order to finish its

process of modernisation. Despite of the fact that the cooperative has plans to provide better remuneration for members. When something like this happens it allows the farmers to have better quality of life and consequently it improves the rural area where these farmers are living. Meanwhile, the committee members need to keep members well informed about all this process in order to have farmers well committed with the institution.

Comparison analysis

- Problems faced in the performance of social function: Analysing the cooperative social function it is possible to notice that before achieving the ideal performance they face many difficulties, in special with respect to the allocation of resources to attend social specific funds. The fund known as FATES, which is a technical and social assistance fund had faced problems with lack of dividends to feed the fund. In the yearly balance the effective surplus is redefined, but the resources that they would have to attend the fund are already used in other financial application. For this reason, most of the cooperatives in Brazil do not have enough funds to support their members and families in their needs. It happened in both cooperatives.

- **The principles of cooperativism:** When analysing the reports of the cooperative members of both cooperatives, the most pointed out difficulties are related to larger issues such as concepts and values of cooperativism. They stated that cooperative principles should be rethought, reorganised, modernised and motivated through an intensive educational process. The interviewees also mentioned the importance of members participation in their own cooperatives. They said that members should also get together to reach common objectives. Cooperatives play multi-functional roles, not only economic, but also environmental and social that cannot be achieved through commercial relations.

- Main benefits: The members of both cooperatives had pointed out the main benefits they have from their membership. According to them, Coopflor Ltd is worried essentially about a better remuneration of products for members, providing a better product follow up, orientation in the production and effective distribution of the production. It also offers health care plans and has its own processing farm, thus the cooperative does not need to pay rent and consequently has better profit. Alternatively, Coopalves Ltd offers the following benefits: it holds back a bigger sales value of each member in order to reinvest it in the cooperative, offers product follow up, technical assistance and makes products distribution guaranteed. At first glance, some people may say that the first benefit is not a real benefit, but thinking about the near future they can see better results when they invest at the present in a common objective.

- Chances of improvement: Here it is described the opinion of members on the opportunities offered by each cooperative and what development they provide on production and social area. Coopflor Ltd is subsidising farmers' interests with its own profit; it offers several programs for production increase and invests in technical training courses. While, Coopalves Ltd provides loans with subsidised interests and invests in partnerships with other companies in the productive area and also in the technical area too.

- Perspective of future: It is told after that, how cooperative members contemplate the future of their own cooperatives. Coopflor Ltd: According to the interviewees, they had been felt relatively unsafe, not for the cooperative, but involved by the current instability of milk

market in Brazil, which suffer many difficulties in the beginning of this millennium. Coopalves Ltd: According to the interviewees, they fell in the best possible form, because in two years only they had already practically paid their financial loans and, they are already searching new credit facilities for investments.

- Perception/point of view about a cooperative: The members of Coopflor Ltd stated that cooperatives and like other companies are excessively formed by partners and capital, and both are always searching for profitability. Coopalves Ltd members stated that cooperatives are different from other organisations and companies because they have to attend social function. In this case, the interviewed members are more awareness about the social role that cooperatives may play if people know more about their principles and aims.

- Problems in the performance of the cooperatives: The problems pointed out by the majority of the members in both cooperatives are shown here. In Coopflor Ltd, the associates had affirmed that they lack "real" members' participation in order to decentralise decisions. In Coopalves Ltd, the associates did not want to provide information on this item. It may reflect a good performance of the cooperative or lack of commitment with this matter. However, taking into consideration the cooperative is providing good services to its members the former seems to be the most appropriate option.

- Difficulties faced by the cooperatives: The main difficulties faced by both cooperatives were also addressed here. Coopflor Ltd: Market for milk products is very recessive and there is an incited competitiveness in this market. A part from these issues, the competitors are always trying to conquer its producers offering better conditions to them; and most of the members do not have a professional conception of their own business and some times the farmers do not offer enough milk pushing the cooperative to deny orders made by clients. In the case of Coopalves, the members did not mention any difficulty.

Within this analysis about the reality of these two cooperatives, it was clearly for the members' point of view that something else needs to be done by the cooperatives, mainly in the social area. Many members felt as victims of the system and they believe the committee members do not do as much as possible in the social area, because they do not know enough about their rights and duties. It is clear that committee members should have a better training to manage cooperatives, like managers in private business have in order to influence policy making and institutional reforms for improving livelihoods and quality of life of the rural people.

Conclusion

From the results of these case studies, it is possible to affirm that cooperatives are relevant for their members and to the development of their own regions. The gathered data showed that good quality communication and flow of information are important to get the best of the members' involvement with their institutions. Mutual aid and reciprocity among partners are basic principles for development of membership, thus having a world more just and balanced.

Active, conscientious and integrated participation among members and committee members as well as among cooperative members and their families and potential consumers is essential to understand the cooperativist doctrine that considers improving of social aspects of life by

means of economic development together with the social development as a good way of making a better world starting from improving quality of life in local region. Cooperatives are enterprises of social picture, not companies with interests above their members, thus the actions of members will indicate if cooperatives will also reach their social goals in future.

In short, it is important to improve the level of commitment among members, committee members, employees and consumers in order to have a better quality of life for the whole society. In this case, education and training play a relevant role in this process because people need to change their values in order to get the best of their own cooperatives. So that, for the cooperativism grows in the desired direction it is necessary to give attention to two basic issues: the establishment of a law that evaluates the cooperatives and the communication process among all people involved on them, and better formation of human resources to develop the movement, in all levels: members, committee members and employees.

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Buildding Social Infrastructure for Decentralized Natural Resource Management

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Abstract

This paper describes the process, successes and failures associated with developing a new platform (community-based natural resource management committee) for an ethnically diverse population (involving CSO, NGO, and government stakeholders) in the context of West African decentralization and supportive of local NRM decision making. The objective of the effort was focused on raising awareness of NRM issues and building leadership capacity to increase the horizontal linkages between stakeholders in the belief that such a common action platform can increase the flow of information and open debate leading to more carefully considered management decisions and, as a consequence, increase trust between communities. We demonstrate that building associational life is not only a matter of gathering people together -- men and women, regardless of ethnic or socio-professional status -- but also requires the development of individual capacities (training in functional literacy, association management, financial management, NRM texts, laws and codes, improved NRM practices, management and reconciliation of the conflicts, etc.) in order for them to assume active roles in the development of their community and in the development of extra-communal relations. The role played by training in conflict management to build self-confidence and platform credibility was critical.

Decentralization has changed the dynamics of natural resource management (NRM), but it has not yet yielded a methodology for effective local governance in the Sahel. In response to this insufficiency, the Sustainable Agriculture and Natural Resource Management (SANREM) Collaborative Research Support Program (CRSP) initiated a program of action research to assist a local population in determining a new modality for management, in accordance with its environmental and socio-cultural context[1].

We began with the idea that a new platform for inclusive community action was required based on the premise that it was insufficient simply to revive old institutions and traditions or to work with one group of stakeholders at the expense of another. Recognizing that group, rather than individual, decision makers needed to be targeted; we set out to foster a social infrastructure that could shape social capital for rural civil society. The objective was to increase the horizontal linkages between stakeholders in the belief that participation in a common action platform can increase the chances that diverse ideas and people will: (1) increase open debate; (2) increase the flow of information; and (3) lead to more carefully considered management decisions and, as a consequence, increase trust between communities.

This paper describes the establishment and operation of such an institutional innovation in the socio-political organization of a rural Sahelian community. The

Natural Resource Management Advisory Committee (NRMAC) is an inter-village and pluri-ethnic civil society organization (CSO) in the Commune of Madiama, *Cercle* of Djenné, 5th Region of Mali. Beginning with a description of the institutional/organizational context, we then present the process of NRMAC formation and its subsequent activities. The discussion highlights the significance of the organization's legitimacy, based as much in customary practice as in modern legal formalities.

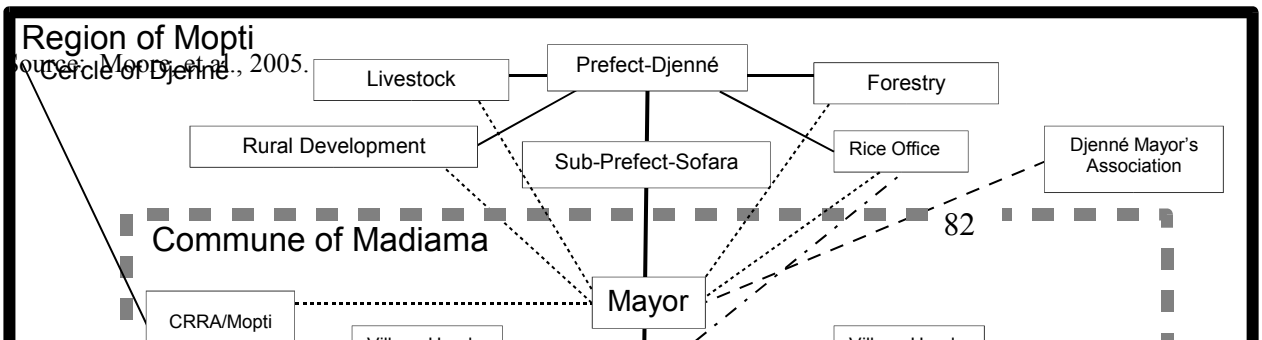
The Institutional Environment

This social infrastructure is designed to build linkages within the local institutional environment and bridges to external organizations and stakeholders (see Figure 1). Two bases of institutional power in rural Mali have vied for control of resource mobilization for development and environmental conservation: state power through the *Chef de Arrondissement* (*Sous-Prefet*) who can bring to bear the police force; and customary power through village chiefs and other assorted resource chiefs, who control the immediate allocation of resources for household livelihoods.

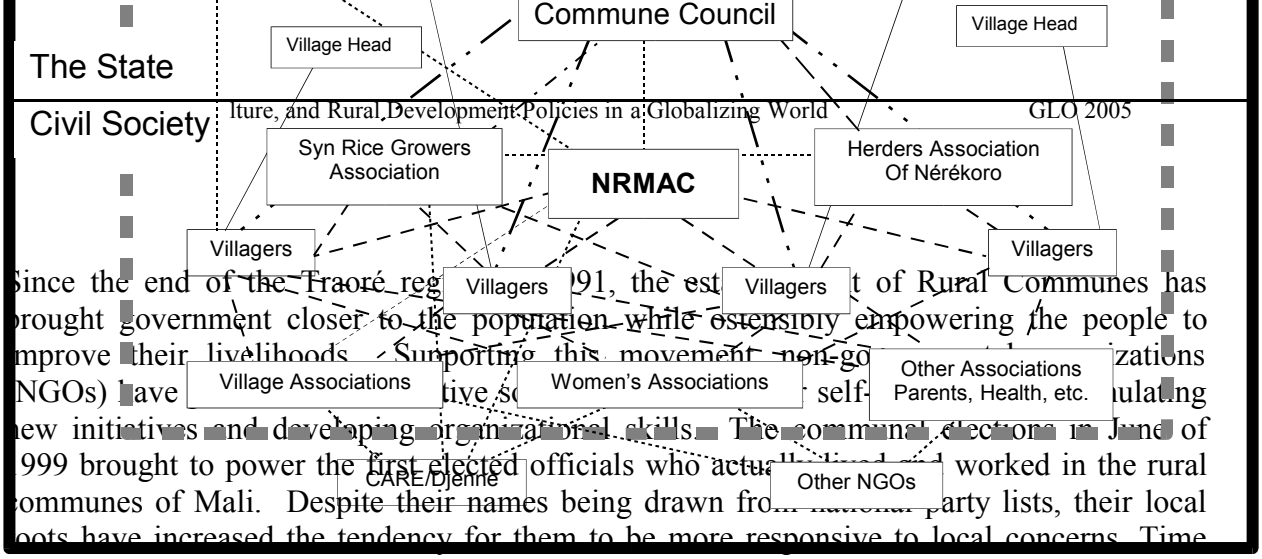
The resources of the state have been mobilized by an array of development services that have attempted to assure environmental protection through threat of law and surplus extraction through development initiatives. For instance, the *Office Riz* has been a major state initiative (reformulated from time-to-time) to enhance the productive power of the peasantry in the production of rice. This effort has been implemented by organizing farmers into village rice growing associations at the village level. The livestock service monitors cattle health and the movement of herds within the zone. The forestry service polices the cutting of wood for fuel and timber to assure that over harvesting does not occur, frequently levying fines and collecting fees for wood cutting. The *Centre Régional de Recherce Agronomique* (CRRA)/ Mopti is charged with developing new and adapted technologies to increase productivity.

Rural civil society has been restricted for the most part to the village level. Village associations are common among men and have provided a point of contact for state development efforts. Women's associations have been largely avoided until recently. The Herders' Association of Nérékoro was established as a local organization to protect the interests of migrant (transhumant) herders who have local bases within the region, but little or no administrative representation.

Figure 1: Network of relationships between the population, government and civil society



Source: Moore, et al., 2005.



Since the end of the Traoré reg 991, the est t of Rural Communes has brought government closer to the population while ostensibly empowering the people to improve their livelihoods. Supporting this movement non-go zations (NGOs) have tive s self- ulating new initiatives and developing organizational skills. The communal elections in June of 1999 brought to power the first elected officials who actu worked in the rural communes of Mali. Despite their names being drawn fro party lists, their local roots have increased the tendency for them to be more responsive to local concerns. Time will tell whether these elected officials will be truly responsive to the expressed concerns of the populations they serve.

Establishment of the NRMAC

In September 1999, a SANREM CRSP-sponsored delegation of national agricultural researchers, the newly elected mayor of the Commune, and representatives of the local *Office Riz* and a World Bank NRM Project visited all ten villages in the Commune of Madiama. In each village, the chief and a group of his counselors were informed about the objectives, value and role of participation in Village NRM User Groups and a commune level NRMAC. The members of the delegation explained that the primary purpose of the NRMAC was to provide a forum for reflection on NRM in order to improve communal resource management. Village NRM User Groups would provide an essential link for communicating technological innovations developed by researchers. The NRMAC would provide a network through which researchers could learn about commune priorities, technology, and information needs and a local platform to prevent, mitigate, and resolve NRM conflicts and to develop a plan for natural resource management.

Each village chief selected five delegates to represent the village in a commune-wide general assembly. According to the relative importance of the activity to village livelihoods, either two herders, two farmers, or one of each were selected. In addition, two or three more villagers were selected to represent women, hunters, and crafts/forest gatherers. Two of ten villages initially declined to participate, but one of them later sent four representatives to the General Assembly. Each of the nine participating villages and the local irrigation management committee sent three to five representatives to the General Assembly meeting held in October 1999.

The Mayor of the Commune opened the General Assembly with the 45 village representatives (including 7 women) and an additional 25 participants, including representatives from research, NGOs, PGRN, deconcentrated government services, Commune Council, and the *Sous-Prefet*. The anticipated objectives, role, and structure of the NRMAC were again described. Translations into the two local languages (Peular and Bambara) were provided. Participants were divided into four discussion groups (organizational and administrative issues; dryland farming, rice farming and fishing issues; livestock, hunting, gathering, and craft issues; and the role of women) and enjoined to debate the concerns and priorities of the commune with respect to each topic. After these groups reported their conclusions at the plenary session, all research, technical service, NGO and elected officials withdrew and elections were held to form the NRMAC. Eleven men and two women were elected (later 3 more women were added). The village that had originally

declined to participate for political reasons sent a representative to join the committee after it had been established.

Legitimacy of the NRMAC

Four factors contribute to the legitimacy of the NRMAC as a viable community organization. They are all based on the foundation of the participatory approach developed between researchers and the community for establishing and operating the committee. The first involves gaining formal recognition of the committee as a legal entity. The second is the establishment of relationships with stakeholders and partners in the association's environment. The third is serving a valued purpose for the community. The fourth is the re-election of committee members after their first term had been served.

Formal recognition of the association

In order to become a legally recognized association, the NRMAC was required to conform to national laws concerning associations. With the assistance of a local NGO (CARE/Djenné), the General Assembly drafted, discussed, and passed by-laws that were formally approved by the judicial authorities. The NRMAC then formally requested the *Prefet* of the *Cercle* of Djenné for legal recognition. Initially, the *Prefet* refused the association's request, because the domain of the NRMAC activities fell within the range of authorities devolved to the Commune Council. Therefore, the NRMAC requested that the Mayor, who had assisted in the process of association development, send the *Prefet* a letter in support of formal recognition. The Mayor obliged and, upon receipt of that letter, the *Prefet* approved their request. The NRMAC was formally registered as an association by the *Cercle* of Djenné in October 2001.

Relations with other associations, technical services and villages

Partnerships have been developed to provide a framework for productive relationships. These partnerships are either formal ones, conforming to the standards of national civil society, or informal ones, based on shared understandings of customary practice at the village level.

The first step in developing formal agreements of cooperation/collaboration was the signing of a protocol with CARE/Djenné, the NGO providing the NRMAC with institutional development training and assistance. Once formally recognized as a registered civil society organization, the NRMAC also signed a partnership agreement with the Commune Council. This document, perhaps the most significant of the NRMAC's formal protocols, provides a framework for the NRMAC: (1) to influence NRM decisions within the commune; (2) to be consulted concerning decisions of the Commune Council; (3) to be recognized throughout the commune as a significant player in the resolution of conflicts linked to natural resources; and (4) to actively participate in the economic development of the commune[2].

The second type of partnership builds collaborative relationships with customary authorities and villagers. Although not formally documented as are those in modern civil society, these relationships were formed while conducting activities involving the village chief. This kind of partnership began with the establishment of Village NRM User Groups under the direction of the village chiefs. By sending representatives to the General Assembly to elect the

NRMAC, the chiefs, in effect, confirmed the legitimacy of the NRMAC. The reticence of certain chiefs to designate village members to participate in the initial General Assembly of the association bears witness to the validating role chiefs play. This form of legitimacy is fragile and arbitrary in nature. Unlike formal, documented recognition, it may be withdrawn at any moment[3].

A valued purpose

Unless the NRMAC serves the community, community members have difficulty understanding why the association should be of any concern to them. Built on the priority concerns of villagers, the NRMAC's mission has been to promote the management of natural resources in the commune by introducing and adapting technologies to local conditions so that the population can improve their livelihoods. An essential element in this mission involves the management of conflicts generated in the use of natural resources by various community members. By providing such services (e.g., protecting and planting trees, resolving conflicts, and introducing new technologies), the NRMAC legitimizes itself in the eyes of local leaders and villagers.

Re-election of committee members

Validation of this legitimacy was received with the re-election of the NRMAC. Announcement of the process for re-electing NRMAC members was circulated throughout the commune, in each village, and on rural radio. As when it was first constituted, the process started at the village level. The village chiefs reestablished the Village NRM User Groups, and five representatives from each of the ten villages were sent to a General Assembly at the commune seat of Madiama. At this Assembly, presided over by the Mayor and the Sub-Prefect, the NRMAC President and the NRMAC Executive Bureau presented an activity and financial report of their accomplishments during the past three years. After a question and answer session, all the NRMAC members resigned. Following an open debate and consideration of their experience and training, all members of the committee were re-elected by acclamation, thereby renewing their mandate. As an additional outcome of the debate, a commission of peers including a representative from the Commune Council, the village chiefs, and other customary/religious leaders, the CRRA/Mopti, and NGOs working in the area will monitor this new term of office.

Training Received

Before receiving formal recognition as an association, the NRMAC visited each village to develop a list of priorities. These lists, and the committee's consolidation of them, were presented to CRRA/Mopti researchers at a meeting in February 2000. A discussion ensued during which the committee prioritized two bio-physical themes, improved soil fertility in croplands and improved pasture management for researcher assistance. The committee also stressed the importance of reinforcing its organizational capacities. These priorities formed the basis for the initial research and outreach relationship. All training activities were developed and extended in a training-of-trainers format. In addition, a few key leaders of the NRMAC have profited from national and international study tours.

The training of NRMAC members and their local technical assistance partners covered three domains. (1) Holistic Management (HM) workshops focused on applying HM principles to

evaluate on-farm research trials, establish wetlands management, and develop a grazing system for open rangelands. (2) Conflict management workshops focused on consensus building, managing power, managing change, and adapting this training to the management of wetlands and open rangeland grazing. (3) Institutional reinforcement based on an institutional analysis of organizational strengths and weaknesses led to training in functional literacy, democratic governance, financial management and accounting, strategic planning, NRM texts, codes, and laws, decentralization codes and laws, and lobbying.

Since the initial workshops, the lessons learned at these training sessions have been routinely communicated at the village level, at first under the supervision of the SANREM trainers. However, the burden of this communication has increasingly shifted to NRMAC members. To date, NRMAC trainers have designed and implemented five workshops at the village level and hosted a workshop for Commune level representatives across the *Cercle* of Djenné. These events created a framework for exchange and dialogue between the NRMAC and other local leaders, although many villagers appear to have been left out.

Services Provided

The NRMAC has served as an interface for the commune with government services. However, during its first three years of existence, the committee also initiated additional activities.

Monitoring research trials

Improved soil fertility: During the first year, researchers worked with user groups in three target villages. These Village NRM User Groups chose collaborating farmers for the field tests. In the second year, the NRMAC made certain that each of the Village NRM User Groups participated. Trial sites located in each village allowed for this participation. However, not all farmer collaborators managed their plots conscientiously. The NRMAC learned from this experience and more closely monitored the quality of farmer participation in subsequent years. These trials provided a focus for addressing issues of increasing soil fertility within the Commune.

Pasture improvement: Given the complexity of coordinating the management of communal pasturelands, pasture improvement research began more slowly, by building rapport and establishing common objectives within the community at both the commune and village levels. Two open-range rotational grazing sites and ensilage trials to optimize forage resources for women based on *Cassia tora* were ultimately established.

Information exchange

A considerable amount of information filters through the NRMAC. This privileged position allows the NRMAC to learn about new techniques and technologies, codes and laws concerning decentralization and NRM, and develop skills in the management of community affairs, including conflict prevention and management. The primary method of information exchange is through direct contact. The committee holds business meetings on the last Sunday of each month and less routinely animates training workshops at the village level. The Mayor or his representative routinely participates as an ex-officio member in these

events. The village representative on the committee reports the information and/or issues discussed in these meetings to the village chief and to some extent the Village NRM User Groups. NRMAC members are not equally proficient at reporting back to their villages due in part to their educational levels, but also to a reticence or lack of confidence in their own information transfer roles. Consequently, the overall quality of these communications has suffered. Nevertheless, village chiefs report being well informed about NRMAC activities.

NRMAC members have been trained as trainers and have appropriated this training to develop their own training modules, often in a local theatre format, a mechanism that disassociates the individual from the message. This training program has been conducted in four villages. The NRMAC has also conducted four information and awareness building programs on the local radio station (with three rebroadcasts to date). Five committee members, including two women, led each program, with a total of ten committee members participating. These programs have described the NRMAC mission, a campaign to protect the Balanzan (*Acacia albida*), local agreements for the promotion of wetlands regeneration, and issues of decentralized administration.

Forestry services

Early in the life of the NRMAC, the Mayor called upon it to assist him in the promotion of a national campaign to protect the *Acacia albida*. Drawing on the network of Village NRM User Groups, the NRMAC was able to disseminate the message quickly. This action resulted in a reported decrease in damage to this nitrogen-fixing tree.

The NRMAC also led a reforestation effort, purchasing and planting trees. Six villages had sufficient water at the time of planting to assure tree establishment and consequently requested a total of 149 trees of three species (neem, baobab, and néré) were planted. The Village NRM User Groups were responsible for tree planting and watering until these trees were fully established. The head of the *Service de la Conservation de la Nature* (forestry service) was impressed with their independent action and assured them that future support would be available.

Agreement development

The NRMAC has initiated dialogues with selected villages in order to develop agreements for the regeneration of seasonal wetlands in the commune of Madiama. Stakeholder negotiations were initiated in four villages, but due to a lack of consensus in one of the villages, only three villages were retained for the wetlands regeneration program. Negotiations were also begun with neighboring villages and stakeholders in order to establish local agreements governing the sustainable exploitation of these basins[4]

Conflict resolution

Violent conflict in the Commune of Madiama has decreased over the past three years. Although difficult to verify objectively, community members claim that this is, at least in part, due to the awareness building of the NRMAC. The local population deeply appreciates their ability to resolve conflicts locally (i.e., without recourse to the government authorities).

On two occasions, the NRMAC has been called upon to intervene in local conflicts. The first occasion involved the early entry of cattle into the commune. This incident was the result of a need for water and did not actually involve cattle entering unharvested fields. However, other herders in the commune were not happy about this breach of the agreement concerning the date of entry because their herds were still forced to remain outside of the commune. After informing the Mayor of the unauthorized entry into the commune, the other herders were ready to call the *gendarmerie* (of the *Cercle*). However, NRMAC members spoke with the principals in the conflict and negotiated a resolution, thereby avoiding participation of the authorities.

The second incident involved a fight between a Peul and a Marka in the village of Promani. When one of them was seriously wounded, the village chief called the *gendarmerie* and the aggressor was taken to jail in Djenné. It was only after this incident that the NRMAC was called in. Although at this point there was still considerable animosity between the two families, the NRMAC was able to negotiate an entente between them and convinced the family of the wounded participant to withdraw the charges against his assailant, getting him released from jail.

Resource mobilization

The NRMAC has benefited from both technical and financial assistance through the SANREM CRSP project. However, the committee recognizes that it must be able to generate its own resources if it is to maintain a meaningful role in the community.

Internal: NRMAC membership cards have been designed and printed at the expense of the association to provide a credible presentation of the association, and to generate funds through a one-time membership fee. By the middle of 2003, over 250 persons had paid the 500 FCFA fee.

External: Learning of an opportunity to request funding from the *Fondation de France*, the NRMAC considered proposing income generating activities, including animal vaccinations, soap production by women and techniques for seed multiplication. However, it was concluded that its NRM mission would be best served through assistance in the development of a communication strategy for the association. With the assistance of CARE/Djenné, the NRMAC submitted a proposal which was later revised and resubmitted. The *Fondation* later approved the proposal, and the consultancy has been completed.

Summary

The NRMAC has begun to mature as an organization in the service of civil society in Madiama. Founded in both modern legal traditions and customary practice, the NRMAC is on the cutting edge of the transformation in rural civil society in Mali during this era of decentralization. It has provided space for dialogue between villages and ethnic groups and is building the confidence to address sensitive issues involving resource allocation.

NRMAC members see communication as key to NRMAC viability as a CSO. Linkages with CRRA/Mopti researchers, other service providers, NGOs, the village chiefs and the Commune Council place it in the center of an important network of NRM decision makers. With its members trained not only in the management of their organization, but also in how to provide leadership for other community groups at the village and commune levels, the committee has assumed a leadership role in disseminating information concerning new technologies, innovative approaches to community based NRM, decentralization, tree planting and other issues of natural resource conservation. Members have dealt with conflict situations and facilitated their resolution. They have also initiated, but not consummated, the establishment of multi-village resource management agreements. Overall, from the villages to the Commune Council, community members have been satisfied with NRMAC performance and renewed their mandate.

Conclusion

Skills in conflict resolution have led to increased confidence in linkages across ethnic groups and village clans. Has this led to a broad-based local consensus over resource use? No. However, the building blocks for an autonomous civil society are emerging[5]. For this to occur, two conditions are needed: (1) a fully committed national decentralization policy involving protection for minority rights; and (2) new bridging organizations between traditional village hierarchies and the local state. Through a sector-specific (NRM) initiative in Madiama, disparate groups have initiated dialog on critical decision-making issues. This analysis demonstrates the importance of building on traditional social relationships and combining them with linkages across groups for community-based NRM. In this way, viable negotiated solutions can be achieved and a new social contract realized.

Decentralization in Mali has created the opportunity for civil society to emerge. However, further changes at the national level supportive of independent CSOs are necessary for rural civil society to prosper. Decentralization has created the opportunity to build traditional bonds at the village level into a network of relations creating a modern tool at the local state level. However, national leaders and administrators must devolve more authority to match the responsibilities that have been decentralized. At the same time, maintaining an independent judiciary is critical as minority groups assert their rights in a context of shifting local power relations.

Organization at the multi-village, local state level in the Sahel is essential. We believe that donor/NGO emphasis on building village-level associations, while successful in mobilizing local resources for development, is insufficient because: (1) the scale is too small for the costs of extended replication; (2) village social capital is too insular for these associations to have a transformative effect on rural social structures and dynamics; and consequently, (3) these associations can be easily manipulated by national neo-colonial mechanisms of divide and control, and of surplus extraction from the rural population. For rural civil society to grow, linkages between villages must be developed, and citizen networks established. In particular, we recommend the reinforcement of all commune-wide associations which multiply the ties between agriculturalists and pastoralists. We must qualify this in regard to the development of women's role in rural society. Often constrained to remain in the village by tradition, women's village associations are serving to mobilize women in their own

struggles for improved quality of life. These opportunities for women to formally associate should be encouraged.

Finally, a word of caution: creating opportunities for empowerment of local populations takes place in historically specific conditions where power and the "weapons of the weak" are well-entrenched. Development agents trying to encourage the growth of modern civil society should take into account our lessons learned:

(1) Including all stakeholders is a necessary but problematic task.
(2) There is no single model for building social capital, linkages are historically contingent.
(3) Project and partner personnel need to be well trained in participatory approaches.
(4) Power relations and stakeholder interests need to be carefully taken into account.
(5) Development agents must foster synergy between public and private sectors.
(6) Conditions of dependence on external resources should be avoided.

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Endnotes

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[2] The NRMAC pro-actively explored other formal partnerships. To develop collaborative relations, the NRMAC invited representatives of the technical services serving the *Cercle* of Djenné to a meeting. Subsequently, a relationship with the *Service Locale de la Réglementation et du Contrôle* (SLRC), which is charged with protecting the forestry resources of the *Cercle*, was established.

[3] Frequent communication with all partners is essential for effective organizational functioning. However, this communication is more than a matter of transferring information, because it involves continually renewing understandings between the NRMAC and the village chiefs. NRMAC members have regularly kept the village chiefs informed of their activities, the training programs they participate in, and the research activities they monitor.

[4] The objective of these agreements is to minimize conflicts between wetland users, improve the management of pastures, and develop the financial resources to maintain them. The agreements define the parameters of collaboration as well as the roles and responsibilities of each party. Two multi-village agreements have been drafted, but no progress in implementation has been made.

[5] Previously social capital was never explicitly mobilized due to the ignorance or contempt of the administration or the rigidity of its rules and procedures. It can now be seen to have possibilities. For example, all the village chiefs of the Commune of Madiama questioned concerning their perception of the creation of the rural communes (decentralization) noted that it had led to the breaking of relations with the Commandant (*sous-prefet*), that is, with the administration (Touré, 2003). Those same village chiefs also noted the positive contributions of the NRMAC to commune life.

Organizational Legitimacy as a Principle for the Private Provision of Rural Development Activities: Evidence from the Czech Republic

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Abstract

The paper empirically explores farm characteristics determining the private provision of local public goods. The objective is to illuminate the principles of bottom-up contribution to rural development. The analysis considers the case of Czech agriculture and uses survey data for agricultural enterprises from 2004. We hypothesize that separation of production control and ownership in Czech agriculture (high farms' dependence on external shareholder and other stakeholders) has provided incentives for farm managers to engage in rural development-related activities. Results from a Probit model support this hypothesis. They reveal that the probability of providing local public goods is significantly positively correlated with farm size, share of employee ownership and interest differences between managers and owners, and negatively correlated with average size of ownership shares. This suggests that greater farm managers' dependence on the support of the farm stakeholders induces them to invest in legitimacy of their businesses by paying attention to the stakeholders' norms, values and beliefs. Though ongoing structural changes are expected to decrease the role of agriculture in rural development, increasing competition on the factor and product markets increases the importance of legitimacy considerations and thereby motivates growing sensitivity of farm managers to societal norms and values. By influencing the formation of these norms and values, governmental bodies have an opportunity to indirectly stimulate private provision of rural development activities.

Introduction

In Central and Eastern Europe, regional disparities have grown over the years of transition to a stage calling for a high attention. Rural areas are characterized by notably lower income levels, low employment opportunities, a significant role of agricultural sectors, problems of demographic structures with respect to age and education, low population density and underdeveloped infrastructure (Baum et al. 2004; Ratinger et al. 2003). The increasing importance of rural development issues during the transition period in Central and Eastern Europe has motivated governments to adopt a number of policy instruments such as the Rural Renewal Program, support of Small and Medium-Sized Enterprises, or environmental programs. Although these instruments have been used relatively successfully, the rural problems retain their urgency and dictate the need to continue searching for other possible policy approaches. In particular, it is becoming increasingly clear that governmental action alone cannot provide an effective solution to a diverse set of issues related to the development of rural areas, which explains the necessity of greater reliance on partnerships between public, private and voluntary sectors and related bottom-up and participative approaches (Pezzini 2000).

The provision of rural development services and in particular the maintenance of social infrastructure in rural areas were a traditional part of the activities performed by collective and state farms that were established during the socialist era in most of the Central and

Eastern European countries. Among these, we turn our attention particularly to Czechoslovakia[9]. The initialization of market reforms in the Czech agricultural sector at the beginning of the 1990s has caused important changes in the economic mechanism of provision of rural development activities. The privatized and transformed agricultural enterprises have significantly retreated from delivering the social and local public goods related to rural development. As a result, rural areas in the last decade have seen the aggravation of technical and social infrastructure such as public transportation, cultural activities and schools, accompanied by corresponding demographic changes. Still, despite the strong competitive pressure, some enterprises have continued providing costly social and local public goods and maintaining social infrastructure.

The important question in this context is: (a) What motivates agricultural enterprises to offer rural development-related products and services in the competitive market environment, and (b) Why are some enterprises more motivated than others? The objective of the paper is to identify the economic forces which can lead to private provision of rural development activities.

The paper utilizes the theoretical concept of organizational legitimacy. We hypothesize that the provision of rural development activities contributes to farms' organizational legitimacy, i.e., public perception of the consistency between the farms' behaviors and societal norms, values and beliefs. The pursuit of legitimacy is motivated by the expectation that more legitimacy will lead to greater public approval and therefore better access to resources (DiMaggio and Powell 1991). It is further hypothesized that the importance of farms legitimacy is higher in cases of higher degree of resources externalization (owned not by the farm), thus farm higher dependence on stakeholders' support. The theoretical framework of organizational legitimacy sheds light on a new dimension of rural development-related activities which, to our knowledge, has not been accentuated in the literature so far.

The paper is structured as follows. It the next section, we briefly characterize the development of Czech rural areas and the role of agriculture. The third section introduces the basic theoretical concept of organizational legitimacy. In section four, we describe the data and methodology for the analysis. The fifth and sixth sections discuss the empirical results and conclude the paper, respectively.

Czech Agriculture and its Role in Rural Development

In the Czech Republic, about 38% of population live in rural areas and of those roughly 44% are involved in farming. These shares, however, have significantly changed during the last 15 years. In the pre-transition Czech Republic (until 1990), the social role of agriculture in rural areas, especially then of collective farms, was significant (Horská et al. 2003)[10]. During the transition, this role of agriculture tailed significantly away. Between the years 1989 and 2002, the employment in agriculture went down by almost three quarters (from 376 thousand to 140

[9] The Czechoslovak Federative Republic was resolved and on January 1, 1993, two separate Republics were established Czech Republic and Slovak Republic. The further text considers only to the agricultural sector in the Czech Republic.

[10] The social role of agriculture included securing favorable income level, accommodation, boarding, cultural and social self-realization, recreation, pension benefits, help to mothers with children, etc. The publicly-beneficial activities concerned, for example, transportation, road maintenance, or snow cleaning.

thousand employees). Important effect on this reduction had an increase in labor productivity. However, key factor was the elimination or marked reduction of non-agricultural functions of agriculture.

This development was related to the significant structural changes in transition initiated through privatization and market liberalization. From the area of 4 279 876 hectares of agricultural land only 3 682 022 hectares are used for agricultural purposes. Around 70% of the agricultural land is cultivated by 2990 legal entities – agricultural companies – with an average size of 1006 hectares. Farms with average size of 29 hectares cultivate 27% of the agricultural land. Traditional family farms of a size below 100 hectares utilize less than 10% of agricultural land; the share of farms with less than 10 ha amounts in number to 58.2%, but they use only 1.9% from the total area of agricultural land; 90% of agricultural land is cultivated by farms with labor organization characteristic closer to an entrepreneurial organizational schema. Agricultural cooperatives farm on 28% of agricultural land and employ around 30% labor employed in agriculture. The majority of agricultural enterprises are commercial companies, mostly joint stock companies and limited liability companies. Many of the commercial companies as well as cooperatives are assigned by high indebtedness and are significantly affected by the efflux of capital due to the privatization and restitutions of expropriated and collectivized assets, and the redistribution of assets of collective farms (accumulated after collectivization).

An important characteristic of the Czech agricultural sector is the high fragmentation of ownership which contrasts with the dominance of the large-scale farming. This is the outcome of the agricultural reforms which intended to individualize property rights and correct former injustices. At the beginning of transition there were about 3.5 million landowners with average land property of 1 hectare, and roughly the same number of claims to non-land assets. From these around 3.5 million restitution claimants, only 8% were active in agriculture in 1995 and this share has since decreased. Today, more than 90% of agricultural land is leased, while the remaining less than 10% of land is mostly cultivated by individual private farmers. This demonstrates the high discrepancy between the land ownership and land use, which is also analogous for ownership and use of agricultural capital.

In the first half on the 1990s, the state more or less neglected regional policy which let the transition to market economy to effect the development of the phenomenon of high rural unemployment and strong regional economic disparities (Blazek 2001). Horská et al. (2003) identified further problems of rural areas related to the development of the agricultural sector: high income disparity between agriculture and the national economy (75% of the average national level), unfavorable age structure of the rural population and its low level of education, low employment opportunities, low demand for female labor in agriculture, transportation problems, lack of cultural, social and free-time activities, etc. Their study further revealed that most of the social services continued to be provided by agricultural enterprises, though on a drastically reduced scale. Especially the unfavorable economic situation of the agricultural companies was identified as the limitation of the performance of their social function in rural areas. The economy measures in the companies social policy concerned particularly contributions to recreation expenses, boarding, but most importantly reduction of employment. Interesting facet of the company-internal social program which was found to exist in two fifth of informant agricultural companies, is that it was in the majority of the companies considered as an instrument of human capital management developed and

initiated by the companies management and not by personal department as a direct response to employees demands.

Theoretical framework

What motivates private provision of public goods or pro-social behavior? This is a question which has a certain bearing on the extensive literature on the role of non-hedonistic motivation in human economic behavior. In the consumer theory, the non-hedonic motivation can be explained by allowing preferences to be directly or indirectly interdependent across individuals. Stark (1990, 1993) speaks about the dependence of an individual's utility on the utility of others; Andreoni (1988, 1989, 1990) elaborated the existence of implicit external effects of pro-social behavior on an individual's utility. In contrary to this, this paper considers pro-social behavior (in the form of private provision of public goods) not of an individual but of a firm. Similarly as in the consumer theory, the rational of firm's pro-social behavior can be traced back to its effects on firms' performance, if we allow objectives of the firm be dependent on preferences of individual in its environment. We assume that firms engaging in pro-social behavior receive indirect private benefits in the form of better public image and consequently better access to resources. This argument is based on the theory of organizational legitimacy, i.e. consistency of the firm's behavior with societal values, norms and believes, as developed within the new institutional branch of organization theory.

The importance of organizational legitimacy was originally stressed by social theorist Max Weber (1922). He viewed the beliefs in corporate and governmental systems as having implications for their structure, stability, and operation of a system. Parsons (1960) asserted that for organizations to have a legitimate claim in scarce resources, the goals they pursue should be congruent with wider societal values. This conception of legitimacy, emphasizing the consistency of organizational goals with societal values, was later adopted by Dowling and Pfeffer (1975) and Pfeffer and Salancik (1978). Meyer and Rowan (1977) were among the first to call attention to the way in which organizations seek legitimacy and support by incorporating structures and procedures that match widely accepted cultural models embodying common believes and knowledge systems. These examples represent considerable diversity in legitimacy approaches. Common underlying conception was formulated by Suchman (1995) who defines organization legitimacy as follows: "Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed systems of norms, values, beliefs and definitions".

The literature on organizational legitimacy emphasizes the limitations of the traditional understanding of formal organization as a system of coordinated and controlled activities that arise when work is embedded in complex networks of technical relations and boundary-spanning exchanges (where is this definition from). Meyer and Rowan (1977) provide their own view of organizations defining them as 'dramatic enactments' of their institutional environments. According to this view, the source of formal organization is provided by the rationalized institutional elements which are incorporated in organization structures in order to ensure that organizations are legitimate and therefore entitled to public approval and support.

The latter definition does not contradict the former. The distinction between these two views of organizations is based on the recognition that organizations exist in two types of

environments: technical and institutional. According to Scott and Meyer (1991), in technical environments, the major criterion of organizational performance is represented by efficiency and effectiveness of coordination of their work processes, whereas in institutional environments by conformity with institutionalized elements and rules. These two types of environments are closely intertwined and are variously relevant to the behavior of different organizations depending on the specific nature of their business activities and the possibility of controlling their outcome. Where output of firm's activities can be controlled, performance is evaluated by efficiency. Where outcome control is inappropriate, its place is taken by control of structures and procedures, which essentially reflect the requirements of the institutional environment. Performance in both senses, not purely efficiency, is then decisive for the firm's existence.

1Data and Methodology

The data set used in our study consists of 120 agricultural enterprises from an extensive survey conducted in 2004 by the Institute for Agricultural Development in Central and Eastern Europe (IAMO) and by the Research Institute for Agricultural Economics in Prague (VUZE) in the Czech Republic. The survey concerned farms' activities which could directly or indirectly contribute to rural development. The analysis concentrates on larger agricultural enterprises, as the most likely private providers of local public goods. The statistics of the data on the pro-social behavior and provision of local public goods are summarized in the first part of Table 1.

Table 1. Descriptive Statistics

Variables for provision of local public goods	Minimum	Maximum	Mean
Social Employment	0.00	1.00	0.63
Publicly Beneficial Activities	0.00	1.00	0.77
Cultural Activities	0.00	1.00	0.19
Variables for farm characteristics			
Cooperative	0.00	1.00	0.53
Limited liability company	0.00	1.00	0.15
Company age	1.00	13.00	9.78
Non-agricultural production	0.00	0.51	0.10
Specialization	0.12	0.89	0.43
Size	17.10	625.47	159.62
External ownership	0.00	0.98	0.69
Employee ownership	0.03	1.00	0.55
Average ownership	5.00	1450.00	151.35
Ownership differences	0.00	39999.00	1870.93
Intention to decrease number of owners	0.00	1.00	0.53
Democratic voting system	0.00	1.00	0.43
Director's age	30.00	67.00	51.74
Agreement between managers	1.00	5.00	3.66
Agreement between owners	1.00	5.00	3.72
Differences in managers and owners interests	1.00	4.00	1.93

The analysis focuses on the explanation of the choice of three activities. The first variable, "*Social Employment*", indicates whether the agricultural enterprise employs some workers for social reasons. The data reveals that 63% of enterprises still do so. The variable "*Publicly Beneficial Activities*" represents the enterprise's initiative in providing publicly beneficial activities for the municipality or dwellers, such as maintenance or arrangement of villages

and roads or public facilities. Only 23% of the informants do not participate in any publicly beneficial activities for the municipality or local inhabitants. Around 20% of enterprises organize on their own or participate in the organization of cultural events. This is captured in the variable "*Cultural Activities*". The survey also revealed, but is not analyzed in more detail, that from the 81% of the sampled enterprises which are active in non-agricultural production, more than the half do this for mainly or partially social reasons. These activities include , for example, providing catering facilities for workers and elderly people in the community, bus transportation for workers and others, etc. Considerable part, around 40%, of interviewed enterprises have also invited municipality or town representatives to the company's cultural and social events used as the occasion to give a public expression of the enterprises' commitment to support their communities.

The second part of Table 1 provides descriptive statistics for farm characteristics, since one of the research questions is what type of farms are concerned with public (societal) values and provide local public goods. As hypotheses presented in section 3.2 suggest, variables describing the ownership and organizational structures are of interest this question. The first two variables indicate the legal form of the agricultural enterprise - if the company is a cooperative, limited liability company or another form. There are 64 cooperatives, 18 limited liability companies and 38 joint stock companies in the sample. The variable "*Non-agricultural production*" gives the share of non-agricultural production on the total revenues. "*Specialization*" indicates the share of livestock production on agricultural production and "*Size*" is expressed in the total revenues in thousand Czech Crowns (CZK). The ownership structure is proxied by five variables. "*External ownership*" means the share of external investors in the agricultural company to the total number of owners, while "Employee ownership" gives the share of the employed owners to total number of employees. "Average ownership" indicates one owner's share on corporate stock in thousand CZK and proxies the ownership concentration. The variable "*Ownership differences*" indicates the difference between the smallest and largest ownership shares on the company assets in thousand CZK. Another variable providing important information about the decision-making in the company is the system of voting. It is a dummy variable, where "1" describes the democratic voting, i.e. one member one vote, without considering the ownership share. Furthermore, we include the ordinal variable for director's age. The last three variables demonstrate the relationships between managers, between owners, and principle-agent problems, respectively.

Before analyzing what type of farms decide to provide local public goods, we need to understand the structure of the variables describing the farms characteristics. We carry out a principal component analysis to explore the latent dimensions and constructs in the original variables for ownership and production structure as well as other farms' characteristics. Due to the discrete (ordinal) character of most variables, we use non-parametric Kendell's Tau estimates to generate the correlation matrix for the factor analysis. To test the sampling adequacy (significance of latent dimensions) of the included variables in the analysis we utilize the Kaiser-Meyer-Olkin Measure. To test the sampling adequacy of individual variables, we use the Anti-Image Correlation Measures of Sampling Adequacy and communalities. Further details on the analysis will be provided in the result section.

For determining the farm characteristics which are decisive for the choice of the local public goods provision, we define this choice as a traditional binomial discrete choice problem. The models which are able to recognize a choice situation in which individuals must decide among discrete, qualitative alternatives are so-called qualitative response models. Their

common trait is that their dependent variables take only discrete values and the independent variables determine the probability of an individual of choosing one alternative from a choice set. Therefore, the probability choice theory has been developed to capture the effects unobserved by the researcher which help to predict the decision (McFadden 1981). All qualitative response models obtain the values of the parameters of the assumed choice-influencing factors by deriving a function for the choice probability. They thus calculate the probability that an individual or a firm will make a discrete choice from a set of alternatives given the assumed explanatory variables. The explanatory variables assumed to influence the choice of social and local public goods provision are listed in the second part of Table 1. For almost all qualitative response models, the appropriate estimator is the Maximum Likelihood estimator. There are a number of different types of qualitative response models that apply in different situations; the number of alternatives in our case implies that we specify a binomial choice model. We further distinguish the qualitative response models based on the assumption we make on the probability function of the choice, which depends on a vector of independent variables and a vector of unknown parameters. If the distribution is assumed to be standard normal, we speak about a Probit model, and if it is logistic, we estimate a Logit model (Greene 2000). In the binomial case, the question of which distribution to use is unresolved; they mostly provide similar results (Greene 2000). Only Probit model estimates will be presented in this study.

2Empirical Results

The final results of the principal component analysis are presented in a form of rotated component matrix in Table 1. The Kaiser-Meyer-Olkin Measure of 0.675 indicates that the sampling adequacy of the listed variables is high. However, four of the originally included variables were excluded from the analysis due to insufficient latent dimensions with remaining variables. These variables were: Specialization, Differences between managers and owners interests, Average ownership, and Director's age. This indicates that these variables do not sample well with other variables and thus can be individually applied in forthcoming analyses. Using the Latent root criterion (each factor explains at least the variance of one variable), we identified four factors. In the presented solution, the relative explanatory sufficiently high (min. 60 %) and the variables are in fact highly related to one another power of the estimated five factors is 8.2 variables, which implies that they explain 68.4% of the total variance of the 12 variables. The index for this solution is thus. The interpretation of the unrotated component matrix is, in general, extremely difficult and theoretically less meaningful. Therefore, we proceed to the component matrix rotation, which simplifies the interpretation. The Varimax solution is chosen.

Table 2. Rotated Component Matrix with Farm Characteristics Variables

	Component 1	Component 2	Component 3	Component 4
External ownership				
Limited liability company				
Employee ownership				
Democratic voting system				
Cooperative				

Company age
Intention to reduce the owners' number
Agreement between managers
Agreement between owners
Non-agricultural production
Ownership differences
Size

The component loadings in the first component in Table 2 imply significant latent relationship between the share of external investor ownership, the legal form of limited liability company, the share of owners on the number of employees and the democratic voting system. This is at the first glance an unexpected component. However, it has to be pointed out that higher share of external investors on the total number of owners does not mean a high number of external investors. In comparison to other legal forms of agricultural companies in Czech agriculture, limited liability companies are smaller with fewer owners and employees. The mutual correlations indicate that the fewer owners of the limited liability companies are from a larger share external investors and the company simultaneously hires less external labor than other legal forms. They also keep the democratic voting system, which could be an effect of larger ownership shares and the owners' higher risk aversion.

The second component groups variables which define cooperatives which where established in the initial stage of transition (high company age) and which will still likely go through a process of reorganization, since they intend to reduce the number of owners. This suggest high dependence of managers in their intension to reorganize on the owners decisions, otherwise, reorganization would have been already realized. The third component indicates that good relationship and agreement between the owners is related to good relationship and easy reaching agreement between managers. The last group of mutually related variables suggest that non-agricultural production is feasible in larger enterprises and is also characteristic for companies with larger differences in the size of the ownership shares.

The principle component analysis thus helped to identify latent relationship between the chosen characteristics of the agricultural enterprises, which would not be evident from simple correlations. These relations between the variables have to be considered in the analysis of the farm characteristics which may play a role in the decision for a provision of public goods and are important for pro-social behavior. The problem of multicollinearity in the discrete choice model has to be avoided. The loadings of the variables on the individual factors shown in Table 2 imply that information contained in the variables could be substituted by four uncorrelated variables – component scores. Since the analysis mostly deals with ordinal variables, it is not possible to use component scores to develop new variables representing the detected components. Hence, we choose surrogate variables representing detected groups of significantly correlated variables. In this case, possibility of bivariate correlation with the variables excluded from the component analysis cannot be excluded and has to be considered in the choice of surrogate variables. Variables presented in Table 3 are the variables chosen for the final analysis of the choice of social and local public goods provision.

Table 3. Probit Model Results for the Probability of Social and Local Public Good Provision

	Social Employment		Cultural activities		Publicly-beneficial activities	
	parameter	p-value	parameter	p-value	parameter	p-value
Size	0.32**	0.04	0.03	0.85	0.13*	0.07
Agreement between managers	-0.04	0.48	0.04	0.48	0.10	0.11
Interest differences between managers and owners	0.22*	0.07	0.25**	0.04	0.15*	0.06
Director's age	0.22*	0.08	0.09	0.49	0.11	0.41
Average ownership	0.12	0.43	0.22	0.23	-0.18*	0.09
Specialization	-0.20	0.14	0.05	0.73	-0.11	0.40
Intention to decrease nr. of owners	0.19	0.44	-0.11	0.67	0.17	0.53
Employee ownership	-0.01	0.91	0.30**	0.03	-0.14	0.34

*, **, and *** indicate significance at the 10%, 5% and 1% significance level, respectively.

The estimates of the probit model indicate that for all three cases representing the provision of social and local public goods only few variables significantly influence the probability of the choice. We provide the complete models estimates since more parsimonious models do not change the significance. The results show that the larger the enterprise, the older the manager or the worse the managers-owners relationship the higher the probability that the enterprise will be concerned with rural employment. The first determinant, size, likely implies the feasibility of the social employment. It is also plausible that older managers are likely to be more concerned with social employment than younger managers who cold be more motivated by economic performance of their enterprises. The higher probability of social employment in the case of the existence of differences in interests between managers and owners is a finding which comes closest to the motivation derived from the concept of organizational legitimacy. It describes a case, when managers are the most limited by owners interests, case, in which they decide to respond to the societal but also the owners values and needs through the means of showing social concerns. It is intuitive that the motivation for such behavior is to legitimize their actions and eliminate interests differences to improve the companies access to resources. The results show that the differences in managers-owners interests also significantly effect the probability of provision of cultural and publicly-beneficial activities, which underlines its importance. Furthermore, the findings disclose that the probability of organizing cultural activities and providing publicly-beneficial activities is significantly influenced by the share of employee ownership and the size of ownership shares indicating dispersed ownership, respectively. Theories of labor-managed firms (e.g. Miyazaki 1984) suggest that employee ownership is characteristic for less well performing firms, where the employees' motivation to obtain ownership shares is to secure employment. However, they have to be willing to give up on the level of income. If this is the case of Czech agriculture, the survival of enterprises with higher share of employee ownership is dependent on the owners willingness to be a part of such worse performing organization[11] and accept lower payment. The results of the probit analyses could then indicate that cultural activities

[11] This deliberation is supported by findings by Curtiss et al. (2005) which indicate that farms providing cultural and publicly beneficial activities display significantly lower technical efficiency.

are provided as a symbol and instrument of social cohesion. Similar argument building upon the dependence of the farm on the shareholders could be used for the interpretation of the provision of publicly-beneficial activities in the case of enterprises with highly dispersed ownership, i.e. case of small ownership shares.

3Conclusions

The paper has sought to investigate the nature of the motivation for private pro-social behavior which underlies bottom-up and participative approaches to rural development. The empirical results reveal that the probability of private provision of local public goods is higher for agricultural enterprises exhibiting larger size, a higher share of employee ownership, and higher ownership dispersion, and larger interest differences between managers and owners. This supports our hypothesis that, especially in situation of higher dependence of the farms' access to resources on societal environment, managers of agricultural enterprises attach a non-trivial importance to societally endorsed norms and values and comply with them in their activities.
Another conclusion derived from the empirical results is that the transition-specifics, such as dispersed capital and land ownership and its separation from the farm management is a fact which contributed to the preservation of the role of agriculture in rural development. This could be understood to be a crucial factor reducing the negative effect of market competition on rural development in conditions for transition characteristic absence of political actions supporting rural areas. However, it needs to be highlighted that with onward structural changes in agriculture leading to acquisition of the production factors by the farms, the role of agriculture in rural development will likely be markedly reduced. Only competition and new interdependencies between firms and private rural actors generated by new market conditions such as demand for highly qualified labor, or new values embedded in the societal consciousness which lead to a change in demand for goods and functions provided by agriculture, could retain or even boost the private provision of activities contributing to rural development.

The policy implications of our results relate to the ability of governmental bodies to promote rural development by consciously effecting the inclusion of norms and values, which favor the undertaking of rural development activities, into the institutional environment of agricultural enterprises. The conscious manipulation of the institutional environment could represent an interesting combination of administrative discretion, on the one hand, and internalization of incentives by agricultural enterprise managers, on the other. This internalization can be expected to be more effective since it occurs not through the traditional principal-agent relationship but through the rational pursuit of self-interest of local actors. Seeking to achieve indirect private benefits through ensuring compliance with specific norms and values, these actors are led to produce valued local public goods.

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Precision Agriculture: Best Alternative Approach for Sustainable Agricultural Development

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Abstract

Precision agriculture provides a sustainable agricultural system that allows farmers to use resources efficiently and develop and maintain complete input and output records. It is a knowledge-based technological management system capable of optimizing farm profit and minimizing agriculture's impact on the environment.

To establish the technology of precision agriculture as a common practice, there is need to develop transferable guidelines and principles for decision making in crop management. This requires both attentions to the specificity of crop production (i.e crop rotation) of the field. High economic efficiency and ecological benefits are ensured now days only by integrated crop production techniques. Precision agriculture can significantly increase economic and also ecological efficiency of crop management.

The crop diversification and information management are immediately considered to be the two major steps to go for precision agriculture.

Crop Diversification

Bangladesh is endowed with favorable climatic and soil conditions for the production of a variety of crops all the year round. The country is rich in bio-diversity and genetic base. Thus, there are ample opportunities for crop diversification balancing the production of major crops with that of minor crops. A crop diversification program (CDP) was launched in the country during the early 1990's. A systematic arrangement of growing a variety of crops in rotation with rice was undertaken, based on farmers' choice and preferences with respect to soil and climatic conditions, thereby ensuring a variety of diverse dietary standards and an overall improvement in the nutritional status of the rural households. Due attention was given to the protection of nutrient balance in the soil and of all major basic resource endowments in crop production. Improved cropping patterns involving rotation of soil exhausting crops followed by recuperative ones, legumes in rotation with non-legumes, etc., are envisaged to enrich and maintain soil fertility and crop productivity.

The key objective of agricultural development, involving sustainable intensification of rice production and location specific attempts on crop diversification in predominantly small farmer holdings of Bangladesh, has aimed at achieving self-sufficiency in food grains production in a sustainable manner by improving the productivity on a short and medium term basis. Another objective is to attain self-reliance in the longer-term. To enhance farmers' income through the production of high-value crops and to help maintain a better soil structure for long-term sustainability, a recent policy statement of Bangladesh government on crop agriculture has called for a departure from "rice-led" growth to a more diversified production base that includes several non-rice crops. The area under wheat and maize during the period 1995-96 to 1997-98 has registered an increase of 15 and 95 percent respectively. The production of rice has exceeded 22.5 million tones and that of wheat has crossed the 2 million tones mark. Maize production increased by 138 percent during this period. The Government is also implementing programs to promote crop diversification involving

potatoes, oilseeds, pulses, spices and vegetables. Attempts are also being made to bring seasonal fallow lands under cultivation through appropriate packages of seed-fertilizer-irrigation technologies.

The Government also intends to promote commercialization of agriculture through production of export-oriented crops and high-value crops, along with selective small farm mechanization in the short, medium and long-term. In line with the accent on poverty alleviation, the other objectives are to increase rural employment through adoption of modern agricultural practices, achieve low and stable consumer food prices and improve the nutritional status of the population. The objectives focus not only on raising agricultural production but also on creating a vibrant, sustainable rural economy with agriculture at its core.

In order to attain the desired level of crop diversification and to accelerate technological advancement in this direction, the following strategies are being adopted:

· Develop HYVs of desirable growth duration, use hybrid technology and genetic upgrading of non-cereal crops and strengthen seed production programs, particularly in the private sector.

· Introduce diversified cropping systems in order to free upland areas in the winter season for non-rice crops, so as to facilitate introduction of a third crop on the land under irrigated conditions - short duration mustard or a sandwich crop of grain legume could be introduced in between the 'Aman' and 'Boro' rice growing seasons.

· Introduce more efficient extension services, improve drainage and water management, ensure timely planting and soil fertility management, develop infrastructure and post-harvest processing and provide marketing facilities.

· Build up effective backward linkages through contract farming and captive farming; develop post-harvest handling including best quality packaging to prolong the shelf-life and to take care of agro-products from farm to retail markets; and organizing the small farmer households, through increased emphasis on precision farming.

Bangladesh agriculture is at the crossroads from the ecological, economic and ethical standpoints, as much of the motivation for investment in new technologies springs from commercial considerations rather than concern for lasting food and nutrition security.

With most countries in the Asia-Pacific Region concentrating on export of value-added goods and services, Bangladesh is also in a position to benefit from its agricultural potential and become a major supplier of food, especially for the benefit of the ethnic population of Bangladeshis living outside Bangladesh. In order to realize this potential, however, we must understand and adopt the relevant socio-economic matrix for sustained prosperity and evolve a planned approach towards agricultural management for sustaining food and livelihood security.

Information Management and Agro-Ecological Zone (AEZ) database

The information management is another key factor to build the knowledge-based technological capability for optimizing farm profit and minimizing agriculture's impact on the environment and its use in practical decision making at the farm level will be an important foundation for sustainable agriculture in the new millennium.

From the beginning of eighties a national Agro-Ecological Zone (AEZ) database was successfully developed in Bangladesh. The database contains information on the country's land resources including physiography, soils, climate, hydrology, cropping systems, and crop suitability. The database is housed in the Bangladesh Agricultural Research Council (BARC) computer center at Dhaka, Bangladesh, and has been used to generate readily accessible information on the physical land resources of the country for use by researchers, extension workers, and decision makers in land and agricultural resources management as well as agricultural developmentplanning

The AEZ database constitutes the foundation for a new effort to develop a comprehensive multiscale GIS-based Land Resources Information System (LRIS). This updated system is designed to better deal with the intricacies of land resource planning under the complex environmental conditions that prevail in large parts of Bangladesh. The LRIS includes additional databases and procedures, in particular data on socioeconomic and demographic factors influencing agricultural production. The system is being implemented by BARC with financial support from the United Nations Development Programme (UNDP) and technical support from the United Nations Food and Agriculture Organization (FAO).

The technology being used to establish the LRIS includes ArcView GIS; the ArcView Spatial Analyst and Dialog Designer extensions; and Avenue, ArcView GIS software's programming language; as well as multicriteria analysis tools.

Conceptual System Design

At the start of the new development efforts in 1997, an overall system design was established to allow for a dynamic analysis and modeling capability. In the past, natural resources modeling systems were based on static GIS overlays. Due to the limited capacity of computers at the time, the overlay of individual maps, such as soil, climatic, and flood zone maps, was cumbersome, and much time was needed to refine the resulting layer. With the advent of more powerful desktop computer systems and more powerful software tools, such as ArcView GIS and ArcView Spatial Analyst, it has become possible to develop more flexible and dynamic modeling tools.

The approach taken in Bangladesh is to create a dynamic multilayered GIS database in which the component layers are modeled as variables that change over time. Due to the inherent variability of climatic and hydrologic conditions in Bangladesh, an open-ended system that allows for the modeling of a wide range of dynamic scenarios, from the historical record as well as predicted future scenarios, will be of greater use and will yield higher quality results.

The Land Resources Inventory Application

The land resources inventory (LRI) application allows for the classification and mapping of soil characteristics from the LRI database. The LRI contains several attributes describing physical soil characteristics. Since LRI attribute data has a many-to-one relationship to soil

mapping units, the data must first be summarized by the mapping unit and the resulting mix of LRI characteristics classified for mapping purposes.

The LRI summary application was developed using the ArcView Dialog Designer extension. It allows the user to specify the study area, the data to be classified, and the number of classes to create. The user is then able to edit the resulting mix of classes based on the percentage area covered by each class. Classes can be merged and renamed to provide for more effective map output.

Reference: IEDS data bank.

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Impacts of Crop-Livestock R&D on Smallholder Farming Communities in Bangladesh

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Abstract

In the pursuit of the need for generation of technology and its dissemination with the ultimate goal of improving the agricultural systems in Bangladesh, several systems approaches have been followed, the Farming Systems Research and Development (FSRD) being one of the approaches to technology transfer systems evolved to its present form in 20 years. Crop-livestock farming systems research implemented by the National Agricultural Research System (NARS) Institutes during the past 10-15 years in 17 FSRD sites under the umbrella of Bangladesh Agricultural Research Council (BARC), have provided rapid spread and adoption of numerous promising crop-livestock technologies creating varying degrees of positive and significant impacts on production, income and total livelihoods of the smallholder farmers around the FSRD and multi-location trial sites and in the vicinities. Despite some staggering constraints faced by the FSRD practitioners, the crop-livestock technologies as evidenced from the *ex-post* impact assessment of the present study, have brought dynamic and remarkable changes to the rural farming communities in food security and poverty alleviation, employment generation, gender and women empowerment, intensity of land use, income and asset generation, agribusiness development, skill development, organizational linkages, and maintaining a better environment. In view of the distinct possibility of reduction in support levels from donors for FSRD programmes, support from several promising internal sources, notably the projects of the government extension departments, NGOs and private agencies need to be explored and arrangements made for contracts/MoU by BARC and NARS institutes. For organizational and financial sustainability of FSRD, all Agricultural Research Institutes need to incorporate suitable FSRD capacities into their core structures and provide core operational funding support to the FSRD programmes.

Introduction

The crop and livestock are the two major agricultural enterprises, which are so inextricably interrelated that the output of one becomes the input of the other. The interaction and inter-dependence of crop and livestock in the farming systems may well be understood in the following:

- Use of animal power as draft for crop production, transport, hauling and threshing. Crops produce straw, bran, residues and other by-products which, in turn, are utilized by livestock and poultry.
- Use of animal manure to improve soil fertility and household fuel.
- Reduction in overall production risk by combining crop and livestock enterprises.
- Consumption of milk, meat and eggs by the farmers adding significantly to human nutrition.
- Sale of livestock and poultry and their products to improve farm cash flow and stabilize farm income.
- Use of livestock and poultry as "emergency cash" which is important to the small and landless farmers.

With gradual evolution of systems research in Bangladesh, component research institutes developed many cropping patterns and component technologies which increased livestock feed and improved livestock production and income in the rural farming systems. These crop-livestock technologies have created varying degrees of impacts through FSRD interventions. Over the past three decades, increased emphasis has been placed on designing production technologies, which are relevant to different groups of farmers, especially small-scale producers. Recent direction includes greater emphasis on technology transfer and linkages with government agencies, non-government organizations (NGOs), and other private concerns. FSRD scientists, research and development administrators, NGOs and others make numerous choices when searching for improved agricultural technologies.

These FSRD efforts created a need to assess impacts, identify constraints, and sustainability concerns. The objectives of this study, therefore, are to i) review chronological evolution of systems research in Bangladesh, ii) assess impacts of crop-livestock farming systems, and iii) identify constraints to and opportunities for sustainability of FSRD. The introductory statement in this paper is followed by the sources of data, evolution of systems research, impacts, constraints and a conclusion in subsequent sections.

Data Sources

Based on available reports and documents collected from National Agricultural Research Institutes, government organizations, non-government organizations and other secondary sources. A thorough review of the collected materials and the outputs of FSRD workshop held at BARC during 6-7 June 2001 on areas of concern provided important inputs to the preparation of this paper**.** Basically, impact assessment can be of one-shot *ex-ante* or *ex-post* type. The FSRD in its current position is amenable to ex-post type assessment. There are a

number of approaches for studying *ex-post* type impact assessment right from physical observation, experience sharing, target-control comparison, before-after comparison, economic surplus and econometric methods. Index number approach is also used to study the rates of return. Unlike mono crop or enterprise assessment, the impact of the FSRD is expected to have several dimensions that need to be addressed during assessment. Some of these are easily measurable but many are not, some quickly become obvious while others take longer, and some have a direct impact while others have an indirect impact. In order to address all these dimensions of the FSRD type intervention, a particular method or approach is not adequate. The approach used here is in fact an *ex-post* review of the effect of intervention rather than quantitative indicators because of the fact that quantitative indicator cannot be made for many parameters and second, qualitative or descriptive reading better describes the matter. Nevertheless, quantitative assessments have been used wherever found appropriate.

Evolution of Systems Research in Bangladesh

Formal agricultural research in this part of Indian sub-continent began in 1906 and on-farm research was initiated in 1957 with the conduct of fertilizer trials to disseminate knowledge and encourage farmers to use fertilizers. On-farm research on wheat was initiated in 1973 to select location-specific varieties through the financial support of the Government of Bangladesh (GOB). However, the traditional approach to agricultural research for optimization of production from a single crop has not been adequately successful in providing effective crop production systems to the farmers of Bangladesh. The agricultural research institutes had limited on-farm research programmes, and most of these research works were isolated and commodity-oriented. Cropping systems research started in 1974 with trials on cropping patterns and component technologies, involving rice and sugarcane by the Bangladesh Rice Research Institute (BRRI) and Sugarcane Research and Training Institute (SRTI), respectively. The project of BRRI was supported by International Development Research Center (IDRC) through the International Rice Research Institute (IRRI) and that of SRTI by the GOB. The cropping systems research programme was operated in isolation of the National Agricultural Research Systems (NARS) and the other crop commodity research. Nevertheless, such a system approach to production was conceived to be useful. While cropping systems research was being pursued independently by individual institutions, it was realized that instead of individual and non-coherent programmes, there could be a centralized coordinated programme on cropping systems research, taking into account all crops and with broader objectives of developing environment-specific cropping systems. Thus, with World Bank funding in 1979, a National Coordinated Cropping Systems Research Programme (NCCSRP) was initiated by the Bangladesh Agricultural Research Council (BARC) with participation of several NARS institutes, Bangladesh Agricultural University (BAU) and Bangladesh Water Development Board (BWDB). The agricultural research institutes included Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Bangladesh Jute Research Institute (BJRI) and Bangladesh Sugarcane Research Institute (BSRI). The project developed several cropping patterns and component technologies with high productivity and profitability. There were also a few CSR-type programmes undertaken by NGO's and special projects during this period although they were not formally linked either with NCCSRP or the research system.

In 1984, BARI established the On-Farm Research Division (OFRD), largely in an effort to minimize the duplication in on-farm work being pursued by the On-Farm Trials Division, the

Wheat Programme, the FSR Project of the Agronomy Division, the Extension and Research Project, and the Fertilizer Demonstration Project. In addition to a significant number of staff with varying backgrounds and orientations, OFRD inherited a network of over 200 trial sites throughout the country, which were progressively consolidated into the current system of 9 FSRD sites and 82 multi-location trial (MLT) sites.

Beginning in the 1970s, there was a growing awareness of the lack of relevance of agricultural research to the needs of the major clients of the research system - resource poor farmers. Failure to involve the farmers in the research process led to two types of inefficiencies; (a) imbalance between the supply of and the demand for technology, and (b) exclusion of an important source of innovations- the farmer themselves. This led to a strong emphasis on farming systems and on-farm research during the decade of the 1980s. The major contribution of this development was to provide methods for diagnosing farmers' problems, setting research priorities to address those problems and screening potential technologies for their relevance to small-scale farmers' circumstances. Addressing these issues and with expanded mandates encompassing livestock, fisheries and agroforestry in addition to crops, a National Coordinated Farming Systems Research Programme (NCFSRP) was initiated by BARC in 1985 through the Agricultural Research Project II (ARP II) of the World Bank. At this stage, three other non-crop research institutes namely, Bangladesh Livestock Research Institute (BLRI), Bangladesh Fisheries Research Institute (BFRI), Bangladesh Forest Research Institute (BFRI), were included under NCFSRP along with four crop research institutes. The network of FSR sites expanded to 20 covering 12 agro-ecological zones. The importance given to specific commodities and subjects varied between sites and institutions depending upon the interests and mandates of each organization. The NCFSRP was renamed as National Coordinated Farming Systems Research and Development Programme (NCFSRDP) in 1989. In this programme, 'development' component was included mainly to expedite technology transfer process that covered activities such as technology demonstration, field day, farmers' training, etc. to be conducted by the extension service providers like Department of Agricultural Extension (DAE), NGO etc. Since 1989 until 1992 the NCFSRDP was funded by the World Bank's ARP II (Supplement) project. Later, the project was supported by the USAID PL 480 grant until 1993.Thus, the FSRD programmes in many institutes were initiated and have been sustained largely through donor support. As a consequence, allocations have come primarily through the development budget, including provisions for personal emoluments. After 1993, the FSRD programme suffered a serious setback due mainly to fund constraint. During this time, a working group with two national and two expatriate consultants reviewed the programme and recommended funding continuation. The World Bank Supervision Mission during the preparation of the Agricultural Research Management Project (ARMP) also stressed the need for the systems approach in agricultural research and development. Accordingly, the National Coordinated Farming Systems Research and Development Programme was accepted as an important component of ARMP with the World Bank funding. The programme was implemented in 17 FSRD sites under the coordination of BARC since 1996. While BARI operated nine sites; BRRI, BJRI, BSRI, BLRI, BFRI(Fishery), BFRI(Forest) implemented the programme in one site each. Besides the NARS institutes, Bangladesh Agricultural University (BAU) operated two sites with project title "Studies on Integrated Farming (SIF)" with funding from Contract Research Component of the ARMP. BAU started the project in January 1999. In BARC, a full time unit consisting of a National Coordinator and a multidisciplinary team coordinated the programme. At the ARI sites, a multidisciplinary group composed of a Site Coordinator and one scientist from each of the participating

institute operated the programme. ARMP funded the NCFSRDP within BARC and 17 FSRD sites, managed by seven participating ARIs and BAU. A summary of the chronological evolution of systems research in Bangladesh is shown in Table 1.

Table 1.Summary of the conceptual, structural and operational evolution of systems research in Bangladesh.

Year	Programme title	Institutions involved	No. of sites	Funding source
1906	Agricultural research	-	-	-
1957	On-farm fertilizer trials	Dept. of Agriculture	-	Govt. of Pakistan
1973	On-farm wheat trials	BARI	N-W region	GOB
1974-78	Rice-based CP trials	BRRI	MLT sites	GOB
1974-78	Sugarcane-based CP trials	BSRI (SRTI)	Sugarcane zones	World Bank
1979-84	NCCSR	BARC as coordinator. Participating institutes are: BARI, BRRI, BJRI, BSRI, BAU, BWDB	200 MLT sites	World Bank
1985-89	NCFSR	BARC as coordinator. Participating institutes are: BARI, BRRI, BJRI, BSRI, BLRI, BAU, BFRI(Fisheries), BFRI(Forestry)	20 FSR sites	World Bank
1989-93	NCFSRD	Same structure	20 FSRD sites	World Bank, USAID
1996-2001	NCFSRD	Same structure	17 FSRD sites	World Bank

N-W: North-West CP: Cropping Pattern

Commodity-based on-farm research was gradually transformed into cropping systems research, which was subsequently renamed as farming systems research with participation of several NARS institutes including BAU. With donor's interest and expanded mandates, FSRD addressed all the components (crops, livestock, fisheries, and agroforestry) as holistic approach since 1985. However, implementation of crop-livestock integrated programmes was delayed due to inadequate knowledge about conceptualization, recruitment of livestock scientists and lack of technologies.

Results and experiences gained from cropping systems research suggested that only crop component could not improve the farming systems in totality. BLRI was established in 1984 with mandates to develop and transfer livestock and poultry production technologies. A very strong commitment of the government to create employment opportunities for the women and youth, alleviate poverty and nutritional problems of the rural people through the improvement of livestock sector during mid 80's, necessitated crop-livestock systems research in Bangladesh, which was evolved in 1985 under the coordination of BARC. BLRI operated one FSRD site with a multidisciplinary team having crop, livestock and fisheries scientists. The crop-livestock systems research was promoted to all other ARIs including

BAU in 1985. Livestock scientists working in different ARIs were recruited and technically guided by BLRI.

Impacts of Crop-Livestock R &D

The crop-livestock systems research of ARIs have created varying degrees of positive and significant impacts which are delineated in the following sub-sections:

Generation and Spread of Technology

The FSRD technologies are being practiced in 17 sites of 16 districts of Bangladesh covering 15 agro-ecological zones. Total number of technologies developed and transferred as of June 2001 is 95, comprising 48 for cropping systems, 42 for component technology and 5 for integrated systems (Haque *et al*, 2001). A good number of other matured technologies are in the pipeline awaiting for transfer. Impacts of FSRD include the generation, adaptation and validation of a number of location-specific crop-based technologies and other non-crop technologies, which are many times productive than traditional technologies. All of these technologies promise either comparative advantage over previous ones or are net additions to fit the local conditions and utilize the unused potentials of the resources.

The generated technologies are of two types: an improved technology as a replacement of the traditional ones and second, a completely new technology to utilize the opportunities of resources such as land, labour and so on. For example, with respect to the first type (improved) of technology, Jute-T.Aman-Wheat pattern has traditional method as well as an improved method, but the improved method is much more productive than the traditional one. Improved pattern has provided marginal rate of return (MRR) to the extent of 600-800 (Table 2).

Table 2.Marginal Rate of Return (MRR) of Improved Jute-T. Aman-Wheat cropping system over the traditional system.

Pattern	Traditional		Improved		Marginal Change		MRR (%)
	Total Cost (Tk)	Total Revenue (Tk)	Total Cost (Tk)	Total Revenue (Tk)	Total Cost (Tk)	Total Revenue (Tk)	
Jute	15261	35518	17279	48293	2018	12775	633
T. Aman	7625	17417	8522	23986	897	6569	723
Wheat	4834	13886	5235	17075	401	3209	800
Average	2802	4235	5322	7232	720	2992	416

Source: Improved Production System for Jute-T. Aman-Wheat (booklet published by BARC for dissemination, 1993)

The improved pattern: Maize-T.Aman-Potato over B.Aus-T.Aman-Potato and B.Aus-T.Aman-Wheat for Chittagong and Pabna locations is very promising providing 241-400% MRR (Tables 3&4). Similarly, single and double row planting of sugarcane with intercropping are highly promising in terms of economic rates of return as compared to sole sugarcane cultivation (Table 5). The mungbean is being practiced by about 60% of the farmers of Patuakhali. Chickpea coverage in Barind areas is about 10,000 hectares, which could generate benefit worth Tk. 200 million. The development of AEZ-specific technologies has made it possible to utilize those land resources, which were left fallow.

Table 3. Marginal Rate of Return of Maize-T. Aman-Potato (improved) pattern over B. Aus-T. Aman-Potato (traditional) pattern in Chittagong Region.

Pattern	Total Cost (Tk)	Total Return (Tk)	Marginal Change		MRR (%)
			Total Cost (Tk)	Total Return (Tk)	
Traditional:					
B. aus	7046	9162	1004	14981	1492
T. aman	9822	16232	375	7227	1927
Potato	17174	27093	15348	44618	290
All	34042	52787	16727	66826	400
Improved:					
Maize	8050				
T. aman	10197				
Potato	32522				
All	50769				

Source: Maize-T.aman-Potato (booklet published by BARC for dissemination)

Table 4. Marginal Rate of Return of Maize-T. Aman-Potato (improved) pattern over
B. aus-T. Aman-Wheat (traditional) pattern in Pabna Region.

Pattern	Total Cost (Tk)	Total Return (Tk)	Marginal Change		MRR (%)
			Total Cost (Tk)	Total Return (Tk)	
Traditional:					
B. aus	5103	8820	2809	23890	850

T. aman	9843	23380	527	3920	744
Wheat	4110	8840	17652	22840	129
All	19058	41040	20988	50650	241
Improved:					
Maize	7914	32710			
T. aman	10370	27300			
Potato	21762	31680			
All	4006	91690			

Source: Maize-T.aman-Potato (booklet published by BARC for dissemination)

Table 5. Marginal Rate of Return of single row STP of sugarcane with intercropping over sole sugarcane production.

Technology	Total Cost (Tk)	Total Return (Tk)	Marginal Change		MRR (%)
			Total Cost (Tk)	Total Return (Tk)	
Sole Sugarcane	52758	72867	--	--	--
Single row intercropping:					
Sugarcane + Potato	71518	104107	18760	31240	167
Sugarcane + Onion/Garlic	72458	133167	19700	60300	306
Sugarcane + Mustard	60018	75607	7260	2740	38
Sugarcane + Chickpea	58038	74787	5280	1920	36
Sugarcane + Lentil	58568	75057	5810	2190	38
Double row intercropping:					
Sugarcane + Potato Mungbean	87308	123817	34550	50950	147
Sugarcane + Potato Gimakalma	84648	135977	31890	63110	198

Sugarcane + Potato Lalsak	84748	139877	31990	67010	209
Sugarcane + Onion/Garlic Mungbean	89168	166957	36410	94090	258
Sugarcane + Onion/Garlic Gimakalmi	86508	179117	33750	106250	315
Sugarcane + Onion/Garlic Lalsak	86608	183017	33850	110150	325
Sugarcane + Mustard Mungbean	696833	804442	16925	7575	45
Sugarcane + Lentil Mungbean	683333	805952	15575	7725	50
Sugarcane + Cabbage Mungbean	856188	110507	32860	57749	176
Sugarcane + Cauliflower Mungbean	856188	825007	3280	9640	294
Sugarcane + Spinach Mungbean	665188	936007	13760	20740	151

Source: BSRI, 1993

With respect to the second type (new) of technologies, introduction of mustard between T. Aman and Boro rice for several AEZs, Blackgram-Potato+Garlic/Palwal in Rangpur, improved Jute-T.Aman-Wheat, Dhaincha-T.Aman-Chickpea for the Barind area of Rajshahi, Potato followed by different vegetables in the Haor area of Kishoregonj, STP sugarcane intercropped with blackgram and potato, Boro-T.Aman-Bushbean, year-round vegetable production using sorjan technology in Patuakhali area, Potato after T.Aman in Barind area of Rajshahi, homestead vegetables production technologies are a few examples of the new technologies that have been spread to and well received by the farmers. The spread of technologies in the working sites of FSRD and its extrapolation areas is more systematic. Many technologies also transferred partially almost all over Bangladesh through DAE and NGOs.

As many as 10 livestock technologies generated by BLRI have been tested in the FSRD sites and some of them have been disseminated to and accepted by the farmers. Urea-Molasses-Straw (UMS) technology for beef fattening and dairy cattle, algae as cattle feed, straw preservation technique under wet condition, low cost preservation of green grass, broiler, layer, cockerel and pullet rearing packages have been practiced and widely spread through FSRD interventions. The BLRI developed Napier and Jamboo grass introduced in BLRI FSRD site and its vicinity has tremendously attracted Milk Vita farmers for feeding these grasses to their highly productive dairy cattle for augmentation of milk production. The

farmers and Milk Vita, as direct beneficiaries of the technology, are grateful to BLRI and are looking for more adaptive technologies.

To provide considerable amount of green fodder for cattle, maize+pulse intercropping, maize+sunnhemp intercropping, intercropping of maize and sorghum in T.Aman based cropping patterns, defoliation of sugarcane leaves as fodder, deed water rice herbage as fodder, are some of the practices developed by BRRI, BARI and BSRI and tested in the FSRD sites. Maize+grasspea intercropping in Tangail district has produced 17.3 t/ha of fodder with an additional grain yield of 3.47 t/ha and 0.78 t/ha, respectively (BARI, 1992). Rice pruning trial of BRRI in deep water area has provided appreciable herbage yield without grain yield loss (Khan et *al.,* 1990).

Food Security and Poverty Alleviation

The homestead vegetable production technology developed by BARI and integrated farming tested by all FSRD sites of the ARIs and BAU, have largely contributed to attaining food security at the household level in the rural areas and to enhanced access to nutritious food to participating farm families, the poorer ones in particular. Usually, poor farmers do not allocate enough cash to buy vegetables and therefore, they are deprived of nutritious food. The new technologies have provided opportunities to the poor housewives to harvest vegetables from their gardens to cook for their families on a regular basis. Thus, access to and consumption of nutritious food has increased manifold by the participating farmers. The homestead vegetable production technology has been and is being promoted throughout the country by DAE, Hellen-Keller Foundation and various other organizations. Without FSRD intervention, the concept of homestead vegetable production could not be disseminated. There are sufficient evidence that enhanced production due to adoption of improved cropping patterns, vegetable cultivation on and around homestead, cultivating fish in the usually neglected ponds, cultivation of vegetables on commercial scale by traditional subsistence farmers, has increased production and income of the farmers substantially (Alam, *et al*, 2001; ARMP (Farming Systems Part). 2001; BAU, 1999; BJRI, 2001; BLRI, 2001; Nur-E-Elahi *et al*, 2001; OFRD(Barind), 2000; OFRD(Pabna), 2001; OFRD(Jamalpur), 2001; OFRD (Rangpur), 2001). This in turn has helped the farmers in raising their standards of living on a sustainable basis. Remarkable change has happened to the families raising poultry as part of the integrated farming technologies. Rearing of poultry in the non-traditional places of the dwelling houses has facilitated increased income, family consumption, and poverty alleviation.

Employment Generation in the Rural Areas

Involvement with homestead based technologies increased women and youth's employment substantially. Measuring the employment effect of the FSRD is difficult due to attribution problem, as creation of employment opportunities is a function of many interventions both from within and outside FSRD. However, estimated increase for the male employment defined in terms of hours engaged in economic activities is on an average 25-30 percent. Per unit output for the labour has also increased due to the introduction of yield augmenting technology. The contribution of FSRD in developing various cropping patterns has provided with the opportunities of year round employment for the participants. Cropping intensities in the FSRD sites has increased considerably (between 166-230%) which means that farmers

are gainfully employed for more time on the farm as compared to the past (BJRI, 2001; OFRD (Pabna) 2001; Salam, 2001).

Substantial portion of the labour potential remained idle prior to the introduction of FSRD simply because of the lack of technology. Notable improvement in the employment situation has been made for the womenfolk, landless and small farmers. The homestead production sub-component provided excellent opportunity to raise vegetables, grow fruit trees, culture fish in ponds and raise livestock units. Since rural women in Bangladesh usually do not go for work outside home they can now utilize their full physical potential in these home-based economic activities. Historically, women were not involved in activities other than household, now the degree of their involvement in many activities has increased due to FSRD interventions. Development of opportunities for agribusiness has generated additional work opportunities for the male around a good number of technologies. Adoption of tomatoes around Barind FSRD site, marketing of vegetables around almost all of the FSRD sites, spraying of mango trees against mango hopper, etc. has created opportunities for business and subsidiary employment (BLRI, 2001; OFRD(Barind), 2000; OFRD(Pabna), 2001; OFRD (Jamalpur), 2001; OFRD(Rangpur), 2001).

Rearing poultry, mostly by the women and educated youth in the rural areas, provided scope for gainful employment. Introduction of poultry feed shops and marketing of poultry products has opened avenues for male employment (BLRI, 2001; OFRD(Barind), 2000; OFRD (Pabna), 2001). UMS technology has created opportunity for introducing mini dairy farms in the rural areas where subsidiary employment for both male and female members has been created (Table 6).

Table 6. Pattern of utilization of labour on dairy farms.

Farm category	Mandays used per farm per day						Total		All labors
	Family labor		Casual labor		Permanent labor				
	Male	Female	Male	Female	Male	Female	Male	Female	
Large	0.25	--	0.50	--	1.50	0.25	2.25	0.25	2.50
Medium	0.50	0.75	0.40	--	--	--	0.90	0.75	1.65
Small	0.50	1.00	--	--	--	--	0.50	1.00	1.50
Average	0.45	0.66	0.32	--	0.30	0.05	1.07	0.71	1.78

Source: Alam , J. 1994

Gender and Women Empowerment

The FSRD personnel's frequent counseling and visits to the women participants and training imparted to them about the technologies have resulted in the socio-economic empowerment, improved adoption of new practices and better conversation abilities. With the achievement of income augmentation from economic activities, social empowerment of the women as well as relationship among the family members and in-laws have been improved. Participation of womenfolk in the homestead based technologies such as vegetable gardening, poultry farming, beef cattle fattening, dairy cow rearing, fish culture and raising fruit trees has been very considerable. All these activities have provided work opportunities not only to housewives of many marginal and small farm families but also to other female members of the household covered by the FSRD sites (BLRI, 2001; OFRD(Pabna), 2001; Salam, 2001). Consequently, income earning ability, awareness, self-confidence, and involvement in decision making process of the housewives have been dramatically improved. This certainly reflects a kind of empowerment.

Intensity of Land Use

Perhaps the greatest contribution of FSRD is on the utilization of land resources. The development of location-specific technologies has influenced the utilization of the surface land to a great extent. The vast land of the Barind area in Rajshahi remained fallow prior to the introduction of FSRD. Similarly, technologies in the coastal areas (such as Patuakhali) were traditional in many situations. That pattern of land utilization has now been changed dramatically. Afforestation by different fruit and tree species has made grey Barind green. Huge areas have been brought under improved crop production. New areas have been planted to crops like chickpea, watermelon, maize, mustard, mungbean and rice. Some 10,000 hectares of land are now under chickpea cultivation in Barind areas, which is essentially the contribution of FSRD. Deficient vegetable areas in Barind and other areas have surplus production (OFRD-Barind, 2000; Salam, 2001). The surface land as well as space above the surface of the homesteads of the FSRD sites, have been used intensively (OFRD-Pabna, 2001; Zaman *et al*, 2001). The dikes of the ponds are being used for growing vegetables, homesteads are being grown with a number of vegetables. As many as 25-30 different types of vegetables are being practiced in one plot using *sorjan* technique in Patuakhali. Areas previously deficient in vegetables are not only now self sufficient, a good portion of them is entering into the market. Intercropping of Palwal and Cabbage has been a highly profitable practice, which has expanded considerably in the vicinity of Karimgonj in Kishorgon (BAU (undated)). Sugarcane intercropping in Ishurdi and its multiplication in other sites are other examples of intensive land use (Rahman, M. K. *et al*, 2001).

Poultry-fish integrated programme in many FSRD sites has increased vertical land intensity through the use of pond water for fish culture and the space above the ponds for raising poultry species, namely duck, broiler and layer (BARI, 2000; BLRI, 2001; OFRD-Pabna, 2001).

Income and Asset Generation

The new ideas and new technologies provided by FSRD to the beneficiaries, have in turn helped them raise income significantly. Landless and poor marginal farmers gain more out of

non-crop intervention (such as poultry, duck, vegetables) as they have little scope to take advantage of crop-based intervention. Large farmers on the other hand gain more from both crop and non-crop intervention by virtue of their higher resource endowment. In addition, the increased income has provided opportunity to improve livelihood and socio-economic condition. Opportunities for renovation of house, addition of small household assets, buying of land, addition of tubewell and sanitary latrines are the results of increased income. The saving at hand is another significant dimension of the FSRD intervention. Examples can be cited from Dhalia-Randia and Kamalbhog sites of the Farming Systems and Environment Studies (FSES) intervention of the Bangladesh Agricultural University in which highest incremental income was received by the landless farmers (242% and 260% respectively compared to 133% and 143% of the large farmers, Table 7). As per the contribution of different sub-systems is concerned, livestock sub-system provided the highest incremental income (793%), followed by 278% from the homestead, 244% from the fisheries sub-system and lowest (228%) from crop sub-system (Table 8).

Table 7. Incremental Gross Margin realized due to FSES intervention in two sites of Valuka, Mymensingh.

Farm category	Gross Margin before intervention		Gross Margin after intervention		Incremental Gross Margin (%)	
	Dhalia-Randai	Kamol bhog	Dhalia-Randai	Kamol bhog	Dhalia-Randai	Kamol bhog
Landless	4423	15264	10718	39714	242	260
Small	24313	23212	49167	46520	202	200
Medium	29737	77981	47655	150078	160	192
Large	57925	247644	77010	355527	133	143
All	19813	91025	36194	145056	183	159

Source: BAU (undated).

Table 8. Incremental Gross Margin realized due to different types of intervention in Valuka, Mymensingh.

iSub-System	Gross Margin before intervention	Gross Margin after intervention	Incremental Gross Margin
Homestead	8590	23905	278

Livestock	9360	74244	793
Fisheries	6350	15520	244
Crops	38270	87299	228

Source: BAU (undated).

Through field visits in FSRD sites it was observed that prior to FSRD intervention, a farmer in Tangail used to earn Tk. 2410 from homestead and Tk. 5058 from his livestock. His income from these two components after intervention has increased to Tk. 4849 and Tk. 12300, respectively. One year after the intervention his total income has increased by 20.46%. Similarly, Mrs. Nurunnahar, a very poor and landless woman in Barind, once begged monetary help to the FSRD personnel for covering her rooftop. Instead of money, FSRD scientists gave her some homestead technologies and training. In one-year time she could cover her rooftop with straw, expanded the homestead gardens, added a fish component in her small pond, and introduced broiler farming in her homestead area. Integrated rice-fish, duck-fish, layer-fish programmes have provided increased income to the adopters in many areas.

The Urea-Molasses-Straw (UMS) technology for beef cattle fattening practiced in 12 FSRD sites has generated average net income of Tk. 3823 compared to the farmer's traditional practice of Tk. 1400 (Table 9). Production and income from milk, broiler, layer and cockerel rearing has generated substantial income in many locations (Islam, 2001). Poultry rearing in the BLRI FSRD site in Serajgonj, has enabled some farmers to have substantial income and savings in the bank.

Table 9. Results of on-farm trials of UMS technology for cattle fattening.

FSRD locations	Period of trial	No. of farmers	No. of cattle	Results		
				Live wt. gain (g/d)	Net return (Tk./animal)	BCR
Serajgonj	1998-2001	225	265	830 (349)	7500 (1800)	2.8:1
Pabna	1997-2001	88	212	789 (350)	7270 (1650)	2.0:1
Rajshahi	1998-2001	60	180	680 (232)	4750 (1195)	1.5:1
Ishurdi	1998-2001	90	140	518 (205)	4000 (1800)	1.46:1
Faridpur	1998-2001	50	110	450 (205)	3500 (1450)	1.43:1
Jessore	1999-2001	32	48	470 (180)	3200 (2218)	1.76:1
Jamalpur	2000-2001	9	24	275 (115)	2250 (650)	1.38:1
Tangail	1998-2001	90	90	477 (183)	3540 (1660)	1.41:1

Sylhet	1997-2001	20	27	275 (95)	3500 (1300)	1.80: 1
Noakhali	1999-2000	7	10	450 (229)	1350 (542)	1.75: 1
Gazipur	1998-2001	42	42	490 (160)	2950 (2000)	1.73: 1
Manikgonj	1999-2000	20	20	334 (117)	2064 (549)	1.50: 1
Total		773	1168	503 (202)	3823 (1400)	

Bracketed figures are the results of control group.
Source: Islam, 2001a

Development of Agribusiness

FSRD has made and is making significant contribution to the development of agribusiness by creating service opportunities for rural people and by creating markets for disposal of surplus vegetables and agro-livestock products. Generation of many technologies has created avenues for agribusiness. For example, looking at the successful potato cultivation in Barind area in Rajshahi, a cold storage owner is now contracting large number of farmers to grow potato. This is allowing the cold storage owner to ensure utilization of his facility to the fullest capacity and ensured income and employment opportunities to the farmers of the area. Similarly, a few villages around Barind FSRD site has become a major tomato producing area and buyers are shipping tomatoes to Dhaka and other places. Considerable responses are received for the demand of spray machines required for controlling hopper in mango tree. Having realized the miraculous result of spray, demand for spray machine has gone up and people in mango growing areas are contacting the FSRD people as to how to procure it. Already a group of people is working as service providers in these areas. The rapid spread of Pungas culture has created tremendous demand for feed in the Pungas growing areas. Since Pungas are cultured in ponds and the technology is spreading fast, demand for Pungas feed has expanded very fast all over Bangladesh. In Valuka and Trishal areas some traders have already started business for the ingredients required for fish feed. A good number of hatcheries have emerged to supply the fingerlings. Considerable progress has taken place regarding marketing of agro-livestock products like vegetables, eggs, broiler and fish and so on. Development of markets and marketing channels and the emergence of market intermediaries are the results of increased production and availability of these agro-livestock products in which FSRD made a significant contribution.

Similarly, use of local ingredients has been started for preparing feed for poultry. A huge number of traders are dealing with business related to poultry feed in the vicinity of FSRD sites. Due to FSRD intervention in the BLRI site, many farmers have started the business of poultry feed and shipping of beef cattle and eggs to the distant places of Dhaka and Chittagong (BLRI, 2001).

Skill Development

Development of skill of different categories of stakeholders through training is a significant contribution of the FSRD. BARC and each of the FSRD sites have imparted training of

different duration to a huge number of scientists of the NARS, GO-NGO officials and farmers. The effect of training to the farmers has direct reflection to their excellent performances in the field and entrepreneurship development. Farmers' training was so effective that sometimes they experiment with technologies to adjust with local condition or to look for higher yield. Mr. Ebadul Hoque, a farmer in the BAU FSES site was awarded **Bangabandhu Gold Medal** for his outstanding performance in farming systems arena (Norman, *et al*. 1997). Another obvious impact of skill development is the poor women's participation and good performance in homestead-based integrated farming.

The impact of training and demonstration is also obvious from farmers' participation and performance in the total farming systems. Substantial impact on skill development has taken place due to field days, farmers' training, staff training, motivational tours for farmers, research station visits, group meetings, workshops of FSRD and site working group meetings. The research personnel with MS, Ph.D. and Post-Doctoral training are another dimension of skill development. In addition, distribution of 1.3 million copies of technological booklets and leaflets to DAE, DLS and other development or promotional agencies has, beyond doubt, created positive impact towards the spread of FSRD technologies.

Impact on Organizations

There are good impacts at the organizational or institutional level from their involvement with the FSRD. NARS institutions and BAU with institution like DAE have improved working relationship and DAE is also doing some extensions of the FSRD technologies. Participation of different officers of DLS, DAE, DOF and NGOs in the working committee has also positive impact on the working environment of the FSRD. Involvement of those organizations with training, workshop, field day and demonstration related to FSRD activities has also improved working relationship. Several DAE projects, e.g. ASIRP, ADIP, TCTTI, SFFP, Nutrition project, etc. have adopted FSR and whole farm participatory approaches. Many of the DAE projects are transferring FSRD technologies. To help DAE in implementing the FSRD approach, DAE have employed several BARI OFRD scientists as consultants. Grameen Krishi Foundation (GKF) has entered into MOU with BARI and has been receiving technical assistance from BARI for improving the command area development. GKF, under BARI's OFRD guidance, is using BARI developed improved cropping patterns and producing several thousand tons of quality seeds of BARI developed vegetable crop varieties.

Environmental Impacts

In addition to the visible impacts described in the previous sections, the FSRD has created several invisible impacts, too. The natural benefit of growing afforestation by the FSRD intervention will be obvious in the long run if not immediately observed. The research on fertilizer trial as well as introduction of *Sesbania rostrata* are very much contributing to the enrichment of soil and increased productivity. Participants are benefited in different ways. *Sesbania rostrata* adds nitrogen to soil, thus reduce fertilizer requirement, is used as fuel and the practice has created agribusiness opportunities. Preservation and recycling of kitchen waste, manures, crop residues, animal wastes, poultry litter and cow dung in crop production do not only save money for farmers but also improve soil fertility and moisture conservation thereby reducing environmental pollution. Soil conservation, reduction of land slides and

productivity in the hilly land agriculture, thereby reducing the negative impacts in environment, was possible due to development of suitable technologies by Bangladesh Forest Research Institute.

Constraints to sustainability of FSRD programme

The FSRD scientists took the challenging job of developing, testing and disseminating technology with strenuous efforts and zeal, yet the activities suffered due to several limitations. Some of these limitations as observed by the author and also reflected in many contemporary reports (BARC, 1993; BARC, 2000; Chowdhury *et al*., 1993; Razzaque *et al*., 1999), are highlighted below:

Inadequate experience of staff

Since inception, most of the FSRD sites have been suffering from lack of adequate and qualified staff. Senior level scientist's reluctance to work in remote FSRD sites often jeopardized site activities. Due to shortage of senior scientists, many sites are being operated by young scientific officers having either no or very limited experience in systems research and technical capability to guide and supervise field activities. For want of technically sound appropriate manpower, specially in the rank of Principal Scientific Officer, monitoring of field research activities suffered to a great extent. The conceptualization of the interaction of different farm components in technology generation and recording of the impact of developed technology on farmers' welfare were affected due to lack of experienced social scientists in the FSRD programme.

Difficulty to follow true holistic approach

FSRD views the farm in holistic manner, focuses on interactions among components and seeks to generate technologies useful to the totality of the development of a farm enterprise. However, it has been extremely difficult to translate this concept into practice. Farming system of Bangladesh is complex, and its production functions are influenced by many interactive factors. Keeping in view the farmers' needs, priority and resources, it is difficult to design and conduct a study encompassing several biological and socio-economic factors, and to analyze and interpret data from holistic perspective. Although farming systems research does not dictate to design an experiment to address all problems together, it suggests that any technological interventions aiming at increasing production of a farm may be termed as farming systems research when it ensures analysis and interpretation of results from a holistic perspective. FSRD goes beyond measuring yield or calculating profit.

Limited policy implementation on inter-institutional cooperation

"Adoption of integrated approach in agricultural development" is one of the important principles of New Agricultural Extension Policy (NAEP). Inter-institutional cooperation is recognized as essential for effective implementation and sustainability of FSRD programme but currently the cooperation is weak due to lack of strong policy decisions for their enforcement at the national level. Toward that end, representatives of all agricultural development agencies need to actively participate in Agricultural Technical Committee

(ATC), a field level forum as outlined in the NAEP. But desired level of participation and sharing could not be achieved. Since various agricultural research institutes and development agencies in Bangladesh are under the administrative control of separate ministries, and work separately in an incoherent manner, understanding and implementation of the systems approach is still inconsistent. There is lack of political will and well defined policy directives from the national level down to the grassroot level for both research and extension workers for participation in FSRD activities.

Weak research-extension-NGO linkage

Although there are fora like Agricultural Technical Committee (ATC), internal review workshops, field days, etc. where research and extension people regularly meet together, discuss issues of common interest and exchange ideas, the quality of output through these activities into the development process is still unsatisfactory.

Too high expectation

Almost everybody expected FSRD personnel to do the job the way they felt. As expected, the District Extension Planning Committees (DEPCs) and ATCs also raised a long list of farmers' problems to be solved by the local FSRD team. Institute headquarter programmes desired various technologies to be tested across sites. Policy makers desired that On-Farm Research Division (OFRD)/FSRD should continuously feed them back with field situation. Sister organizations requested a bit of help in testing some of their technologies while national inter-institutional research programmes wanted OFRD/FSRD's participation. Consultants/donors advised the team to "do this" or "do that", etc. Many policy level persons while visiting the FSRD sites wanted to see research on virtually all components of farming systems, viz. crops, livestock, fisheries and agroforestry, etc. Often scientists found that demands from all quarters are enormous but funds and resources are strictly limited. Therefore, in many occasions the scientists failed to fulfill the desire of many. As such, instead of being encouraged and appreciated, they became the targets of criticism.

Insecurity of job

In the absence of provision of posts under core programme of the NARS institutes, field level scientists and staff were appointed under contract research for implementation of FSRD programme. It was recommended that each institute would gradually integrate on-farm/farming systems programme with its core activities and establish separate division/section. While the ARIs could set up separate division to carry out on-farm and systems-based research, these crop-based research institutes do not have scientists with background in livestock and fisheries. Similarly, there is no crop scientist in non-crop research institutes. In order to run FSRD activities with true holistic manner, all NARS institutes have got to depend on scientists appointed under the project. Therefore, non-availability of scientists with multidisciplinary background has been serious constraint towards implementation of activities with integrated approach. Because of the temporary nature of job, all contract research scientists could not devote themselves fully to their assigned work. Instead, they were looking for a permanent job elsewhere, and meanwhile

many scientists from different sites had quitted. This has seriously hampered programme implementation.

Design and analysis of crop-livestock research

Design and procedures used for experiments on research stations with animals are often not applicable to the highly variable on-farm conditions. While application of statistics to on-station animal research is a routine and the researchers are so confident about the inferences from the data generated, the situation in on-farm trials is quite different. Because of farm conditions many on-farm trials may not be able to meet the assumptions of randomness of the variable, common variance, additivity of the parameters and normality of the distribution of variables under observation. The lack of control and complexity of the farm situation force the FSRD scientists to seek a compromise in rigidity of the experimental design to meet practical requirements on the one hand and precision on the other. In integrated farming approach, lack of appropriate methodologies for design, testing and evaluation of crop-livestock farming systems is seriously limiting validity and interpretation of data. Added to this is the problem of inadequate knowledge-base of the newly recruited junior level crop and livestock scientists about the system.

Sustainability of FSRD

1. **Organizational Sustainability:** Generation of technologies to solve farmer problems and provide opportunities for the future are the core responsibility of ARIs and BARC. ARIs have been trying to achieve this through their on-station research and FSRD activities with various degree of success. Sustainability of the success and continuous improvement is largely dependent upon a good and functional organizational arrangement within each of the ARIs and the NARS as a whole. This issue of organizational sustainability has become a matter of urgency particularly in the non-crop ARIs. In order for the NARS to remain responsive to demands created by farmers, integrate multidisciplinary team work, ensure team work between on-station research and on-farm research, reduce redundancies, integrate at farm level technologies generated by crops research and non-crop research institutes, and ensure feed-back to the on-station research scientists, effective sustainability of FSRD type of work in the NARS has to be ensured.

For organizational sustainability, it is suggested to improve the management of the current structures (FSR Divisions) at crop research ARIs and establish similar structures in the other ARIs where such structures do not exist. The FSR Divisions would provide the core staff for carrying out FSRD work and those from other divisions/disciplines of the ARIs will participate as team members of the FSRD sites.

2. **Financial Sustainability:** In spite of growing evidence of the considerable impacts from FSRD and research in general, the sustainability of FSRD activities following the cessation of donor funding is seriously in question. Assuming that progress can be made in formally establishing the posts of FSRD in all institutes, the problem of operational funding remains a critical concern. There must be a serious plan of BARC and ARIs for financial sustainability, involving the diversification of funding sources to increasingly include domestic sources other than government of Bangladesh.

BARC and ARIs should actively explore funding support through formal contracts with development service providers, notably NGOs and private sector agencies. Such arrangements may, in fact, be a condition of future support from major donors. Concurrently, efforts should be made by BARC and ARIs to strongly convince the policy makers for continuous financial support to FSRD.

It will be very difficult to identify sources of funding for FSRD activities, at least in the near term. Suspension of these research and development activities will pose a serious threat to future flow of technologies and sustain agricultural progress in the country. Thus, measures should be taken to ensure the continuity of at least a modest portion of these activities. The government should provide modest core operational budget support to the FSRD programmes in addition to regularizing the positions of the FSRD staff. The core FSRD research activities should become a regular feature of the operating budgets of the respective organizations and subject to the normal research planning and resource allocation procedures.

Conclusion

Significant contribution to the growth of agriculture in the country was possible through FSRD interventions. Crop-livestock systems research, since inception in 1985 to date, has created enormous impacts on production, income, savings and life style of huge number of beneficiaries. The development of improved cropping patterns for different agro-ecological zones, identification and popularization of suitable crop varieties, contributions to national fertilizer guide, homesteads vegetable gardens, pond cultures, skills and agribusiness development are the contributions of FSRD. Shortage of cattle feed has been minimized at least to some extent through the introduction of fodder crops in the existing cropping patterns. BLRI-developed UMS technology for beef fattening and milk production, high yielding fodder, broiler, layer, cockerel and pullet rearing packages have enhanced production and income substantially including generation of employment for the women and youth, and development of agribusiness and market intermediaries. Dynamic and significant changes in the farming systems in Bangladesh took place due to FSRD scientist's motivation and commitment for hard work in a very harsh environment. Despite this, FSRD programmes suffered due to many constraints. Lack of adequate technical knowledge-base of the staff to effectively guide junior colleagues and supervise field activities, problems in the design and implementation of holistic approach including crop-livestock systems research, lack of strong policy directives and implementation on inter-institutional cooperation, weak research-extension linkage, temporary nature of job, and experimental design, are identified as some of the important limiting factors. For financial sustainability of FSRD, all ARIs should provide modest core operational budget support to the FSRD programmes in addition to regularizing the positions of FSRD staff. The core FSRD activities should become a regular feature of the operating budgets of the respective Institutes.

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More Benefit From Less Land : Rice-Pulse(as vegetable +fodder) - as a More Profitable Cropping Pattern for Resource -Poor Farmers in Bangladesh.

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Abstract

The field experiment was conducted at Pulses Research Center, Ishurdi, Pabna, Bangladesh during 2002-2003 and 2003-04 to find out the economically viable pulses (as vegetable and fodder crop in fallow period between transplant amna rice (Monsoon rice)- Boro rice (spring rice) cropping pattern and to find out the suitable variety of monsoon and spring rice for better establishment of pulses for more benefit of resource - poor farmers in Bangladesh. First crop, monsoon rice (cv. BR-32, BR-39 and BINAdhan-4), 2nd crop, pulses (lathyrus, chickpea and fieldpea) and third crop, spring rice (cv. BR-28, BR-28 and BINAdhan-6) were used in the experiment. Among the monsoon rice varieties BINAdhan-4 produced the highest grain yield (5.2 t/ha and 4.8 t/ha) and straw yield (6.2 t/ha and 5.6 t/ha) and net return (Tk. 43350 /ha and Tk. 38450 /ha) in 2002-2003 and 2003-2004, respectively. The lowest grain yield (3.97 t/ha and 3.90 t/ha) and straw yield (4.5 t/ha and 4.37 t/ha) and net return (Tk. 29800 /ha and Tk 28870 / ha) were in BR-39 in 2002-03 and 2003-04, respectively. Among the pulses (as vegetable and fodder), field pea produced the highest vegetable (3.6 t/ha and 2.9 t/ha), fodder (19.2 t/ha and 17.0 t/ha) and net return (Tk. 38456 /ha and Tk. 30840/ha) in 2002-03 and 2003-04, respectively. The lowest vegetable (1.8 t/ha and 1.20 t/ha) , fodder (7.5 t/ha and 5.5 t/ha) and net return (Tk. 17284/ha and Tk. 9550/ha) were obtained from chickpea in 2002-03 and 2003-04, respectively. Among the spring rice BINAdhan-6 produced the highest grain yield (8.0 t/ha and 7.6 t/ha), straw yield (8.47 t/ha and 8.30 t/ha) and net return (Tk. 67980 and Tk. 64010 /ha) in 2002-03 and 2003-04, respectively. The lowest grain yield (5.3 t/ha and 5.10 t/ha), straw yield (6.5 t/ha and 6.3 t/ha) and net return (Tk.39700 /ha and 37600 /ha) were obtained from BR-28 in 2002-03 and 2003-04, respectively. From two years pooled result, it was observed that, BINAdha-4, field pea (as vegetable + fodder) and BINAdhan-6 produced the highest yield of 5.0 ton/ha (grain), 3.25 t/ha (Vegetable) + 18.1 t/ha (fodder) and 7.8 t/ha (grain), respectively . This cropping pattern combindly (3crops) gave the highest net return of Tk. 141540/ha/year equivalent to $2212/ha/year.

Introduction

Bangladesh is a densely populated country, where population density and per family cultivable lands are, 910/sq.km. and 0.47 ha, respectively (BBS, 2004). Every year cultivable lands are utilized for making housing, office building, roads and others construction work for blooming populations. Day by day the population per unit area increases but cultivable land decreases which is alarming for growing economy of the country. In this endeavor, researchers, extentionist and farmers are trying to increase cropping intensity through the highest utilization of lands to fulfill the requirements of blooming population. Where as, after monsoon rice (July- December) harvesting few lands are used for short duration mustard cultivation before transplantation of spring rice but maximum lands remains fallow. Some farmers of few areas also sporadically cultivate lathyrus (L*athyrus sativus L.*) and blackgram (*Vigna mungo*) as relay crop in the existing monsoon rice field as fodder crop before spring

rice transplantation. But near about 20% of total cultivable lands (82.90 lac ha.) remains fallow in this time .But there is an ample to cultivate winter pulses like lathyrus, chickpea (*Cicer arietinum*) and field pea (*Pisum sativum*) for vegetable by nipping the growing shoot (7.0-7.5 cm apical part of the soft shoot) for human consumption which is chosed by the consumers due to it's good taste. It has also high market price. Akkas *et. al.*,(2000) reported similar findings incase of chickpea. Although, vegetable, harvesting i.e. shoots picking is a time consuming and laborious job but resource- poor farmer's wife and children easily can do this job in their idle time. Nipping of shoot also creates job opportunity to the rural women & children. Growing pulses acts as a catch crop between two rice and provides an extra income to the farmers. In winter season there is a high scarcity of fodder. Where as, after shoot picking, rest of the part of lathyrus, chickpea and field pea will be used as good fodder. By this way, large fallow areas could be brought under pulse cultivation for vegetable and fodder production.

In addition to, pulses are considered as ameliorative crops from a sustainability point of view to break continuos cropping with cereals which improve the soil health Yadav *et. al*. (1994). Reported that, soil aggregation, soil structure, permeability, fertility and infiltration rate is to improve fairly with the inclusion of pulses in the system. A legume cans fix 20-60 kg residual N /ha to the succeeding crop (Ahlawat and Srivastava, 1994). Therefore, legumes, in general, play a vital role in the rainfed ecosystems. For better establishment of pulses in between two rice as relay which varieties of monsoon and spring rice are suitable is not known to the farmers.

Considering the above point of view, the present investigation was undertaken to find out the economically viable pulses (as vegetable and fodder crop) within the fallow period of monsoon rice - spring rice cropping pattern and as well as to find out the suitable variety of monsoon and spring rice for better establishment of pulses for more benefit of resource poor farmers in Bangladesh.

Materials and Methods

A field experiment was conducted for two consecutive years of 2002-2003 and 2003-2004 on Calcareous Gray Food Plain soils of Pulses Research Centre, Ishurdi, Pabna, Bangladesh. The experimental soil was clay loam in texture having pH 7.5, containing 1.2% organic matter, 17ppm N, 26ppm P and 300 ppm K. Season wise, experiment was laid out in RCB design with three replications. Second crop, relay pulses, were placed in the monsoon rice plot in such a way, so that every pulses were placed in every rice varieties' plot. After pulses plants cut for vegetable, similarly, third crop spring rice was placed in the pulses plot where every rice varieties were placed in the every pulses plots. First crop, transplant aman rice i.e. monsoon rice (var. BR32, BR39 and BINAdhan-4), second crop, winter pulses (Lathyrus var. BARI Khesary-1, Chickpea var. BARI-chhola-5 and var. Field pea var. Norail local) and third crop, Boro rice i.e. spring rice (var. BR-28, BR-29 and BINA dhan-6) were used in the experiment. The unit plot size was 5m x 4m.

Ist crop : Monsoon rice

Thirty days-aged seedlings of monsoon rice were transplanted on 10 July in 2002 and 17 July in 2003 in maintaining 25cm x 15cm spacing, respectively. Fertilizers were used @ 60-40-40-20-10 kg/ha of N-$P_2 0_5$-$K_2 0$-S and Zn in the form of Urea, Tripple Supper Phosphate,

Muriate of potash, Gypsum and Zinc sulphate, respectively. Except N, all fertilizers were used at final land preparation. Nitrogen fertilizer was used as top dress into 3 equal split at 15 Day After Transplanting (DAT), 30 DAT and 45 DAT. Weeding was done at 20 and 40 DAT. The crop was harvested on 6 November in BR-39, 17 November in BR-32, 12 November in BINAdhan-4 in 2002, respectively and 19 October in BR-39, 27 October in BR-32, 23 October in BINAdhan-4 in 2003, respectively. Data on yield contributing characters were recorded from 10 randomly selected plants from each plot and grain yield (t/ha) and straw weight (t/ha) were recorded from whole plot at harvest. The recorded data were statistically analysised.

2nd crop : Winter pulses

Different winter pulses i.e. Lathyrus (var. BARI Khesary-1), Chickpea (var. BARI Chhola-5) and Field pea (var. Norail local) were sown in the existing rice field as relay crop and sowing dates were on 4 November in 2002 and 26 October in 2003, respectively. The crop was fertilized with 40 and 20 kg/ha P_20_5 and K_20, respectively before 2 days of pulses sowing. Later on, N-40 kg/ha was top dressed into 3 equal split at 20 Day After Emergence (DAE), 40 DAE and 60 DAE at afternoon due to less soil moisture. The tender twig of each pulses were clipped for vegetable. Shoot picking for vegetable was stated on 52 DAE in lathyrus, 56 DAE in chickpea and 52 DAE in field pea in 2002-03. Similarly, in 2003-04 it was started on 54 DAE in lathyrus , 59 DAE in chickpea and 54 DAE in field pea. Last harvest of vegetable was on 102 DAE in lathyrus, 100 DAE in chickpea and 102 DAE in field pea in 2002-03. Similarly, in 2003-04 it was on 100 DAE in lathyrus, 95 DAE in chickpea and 100 DAE in field pea. Always after the collection of vegetable, it weighted. After the last harvest vegetable, pulses plants were cut and weighed and used as fodder. The recorded data were statistically analyzed.

3rd crop : Spring rice

After fodder harvesting, 35 days aged seedlings of BR-28 and 60 days aged seedlings of BR-29 and BINAdhan-6 were transplanted on 7 February in 2003 and 8 February in 2004, respectively. Fertilizers were used @ 60-80-40-20-10 kg/ha of N-P_20_5-K_20-S and Zn in the form of Urea, Triple Supper Phosphate, Muriate of potash, Gypsum and Zinc sulphate, respectively. Except N, all fertilizers were used at final land preparation. N fertilizer was top dressed into 3 equal split at 15 DAT, 30 DAT and 45 DAT. Weeding was done at 20 and 45 DAT. The variety BR-28, BR-29 and Binadhan-6 were harvested on 3 13 and 21 May in 2003 and 2, 12 and 20 May in 2004, respectively. Data on yield contributing characters were recorded from 10 randomly selected plants from each plot and grain yield (t/ha) and straw yield (t/ha) were recorded from whole plot at harvest. The recorded data were statistically analyzed

All types of production cost were recorded to find out the net return and benefit cost ratio. Economic analysis were computed as follows:

Cost of production = Inputs + operational costs
Gross return for rice = grain yield x price
Gross return for pulses = Vegetable x price + fodder x price
Net return = Gross return - cost of production
Benefit cost ratio (BCR) = Gross return / cost of production

Results and Discussion
1st crop : Monsoon rice

The two years results with pooled figures of yield and yield contributing characters of different monsoon rice varieties are presented in Table 1a and 1b. Significant difference was observed among the three varieties in case of filled grain/panicle, 1000 seeds weight, grain and straw yield but others characters failed to produce any significant difference. Numerically the highest plant height 109.63 cm, 107.0 cm and 108.50 cm were recorded in BINAdhan-4 in 2002-03, 2003-04 and by pooled, respectively. The lowest plant height 99.70cm, 98.00cm and 98.85cm were in BR-39 in 2002-03, 2003-04 and by pooled, respectively. Numerically the highest effective penicle/hill 8 in BR-32 & BINAdhan-4 and the lowest 7 in BR-39 for both the years and pooled, respectively. Significantly the highest filled grain/ penicle 109, 107 & 108 were obtained by BINAdhan-4 and the lowest 84, 82 and 83 were in BR-39 in 2002-03; 2003-04 and by pooled, respectively. Significant difference was observed in 1000 seeds weight and it was the highest 22.85 g, 22.83 g & 22.84g were in BINAdhan-4 and the lowest 21.24g, 21.20g & 21.22g were in BR-32 in 2002-03, 2003-04 and by pooled, respectively. The highest grain yield 5.20 t/ha, 4.80 t/ha & 5.00 t/ha were obtained from BINAdhan-4 in 2002-03 , 2003-04 and by pooled, respectively. which might be due to cumulative influence of increased plant height, number of effective penicle /hill, number of filled grain/penicle, 1000 seeds weight. BINA (2001) reported the similar results. The lowest grain yield 3.97 t/ha, 3.90 t/ha and 3.94 t/ha were obtained from BR-39 in 2002-03, 2003-04 and by pooled, respectively. Significantly the highest straw yield 6.20 t/ha, 5.60 t/ha and 5.90 t/ha were obtained from BINAdhan-4 in 2002-03, 2003-04 and by pooled, respectively. The lowest straw yield 4.5 t/ha, 4.37 t/ha and 4.44 t/ha were obtained from BR-39 in 2002-2003, 2003-2004 and by pooled, respectively. There was not much difference in crop duration but numerically the highest duration 128 days 130 days and 129 days were in BR-32 in 2002-03, 2003-04 and by pooled, respectively. The lowest crop duration 121 days 125 days and 123 days were in BR-39 in 2002-03, 2003-04 and by pooled, respectively.

2nd crop: Winter pulses

The two years results with pooled figures of vegetable and fodder yield of three pulses are presented in table 2a and 2b. Significantly the highest duration of first harvest of vegetable 56 DAE, 59 DAE & 57 DAE were observed in chickpea in 2002-2003, 2003-2004 and by pooled, respectively. The lowest duration of first harvest of vegetable 52 DAE, 54 DAE and 53 DAE were found in lathyrus and filed pea in 2002-2003, 2003-2004 and by pooled, respectively. Differences on last harvest of vegetable had no significant effect among the different pulses in both the years and also combined result, but numerically the longest duration of last harvest of vegetable 102 DAE, 100 DAE and 101 DAE were observed in lathyrus and field pea in 2002-2003, 2003-2004 and by pooled, respectively. The lowest duration of last harvest of vegetable 100, 95 and 97.5 DAE were observed in chickpea in 2002-03, 2002-03 and by pooled, respectively. Total duration of vegetable harvesting was not significant difference in 2002-03 and by pooled results but significant difference was in 2003-04. Numerically the longest duration of vegetable harvesting 50 days and 48 days were observed in lathyrus and field pea in 2002-03 and by pooled, respectively The lowest duration of vegetable harvesting 44 days and 40 days were found in chickpea in 002-203 and by pooled, respectively**.** Significantly**,** the longest vegetable harvesting duration 46 days was in lathyrus & field pea and the lowest was 36 days in chickpea in 2003-04. Significant

difference was observed in the frequency of vegetable harvesting and it was the highest 8.0, 7.0 and 7.5 were in field pea which was identical to lathyrus and the lowest 6.0, 5.0 and 5.5 were in chickpea in 2002-03, 2003-04 and by pooled, respectively. Significantly the highest vegetable 3.6 t/ha, 2.9 t/ha and 3.25 t/ha were obtained from field pea in 2002-03, 2003-04 and by pooled, respectively which might be due to cumulative influence of early start of vegetable harvesting, longest duration of vegetable harvesting and significant increase of vegetable harvesting frequency. The lowest vegetable production 1.8 t/ha, 1.2 t/ha and 1.5 t/ha were observed in chickpea in 2002-03, 2003-04 and pooled, respectively, due to it's later start vegetable harvesting and shortest harvesting duration & the lowest frequency of vegetable harvesting. The highest fodder weight 19.20 t/ha, 17.00 t/ha and 18.10 t/ha were obtained from field pea and the lowest 7.5 t/ha, 5.5 t/ha and 6.5 t/ha were in chickpea in 2002-03, 2003-04 and by pooled, respectively. The highest fodder weight was in field pea, it might be due to higher frequency of shoot picking which resulting higher number of branches production. Akkas, *et. al.,* (2000); Agrikar (1990) and Saxena & Sheldrake (1979) reported that clipping of the young shoot during vegetative growth caused in increase in auxiliary branches which resulted higher by product in chickpea.

3rd crop: Spring rice

The results of two years and pooled of yield and yield contributing characters of different spring rice varieties are presented in table 3a and 3b. It appears that, the plant height was not significantly difference among them but numerically the highest plant height 103.2cm, 102.10cm and 102.65 cm were obtained from BINAdhan-6 in 2002-03, 2003-04 and by pooled, respectively. The lowest plant height 90.30 cm, 88.20cm and 89.25 cm were obtained from BR-28, in 2002-03, 2003-04 and by pooled, respectively. There was no significant effect of varieties on number of effective penicle/hill, however, the highest number of effective penicle/hill 14 in BINAdhan-6 and the lowest 12 was in BR-28 in 2002-03, 2003-04 and by pooled, respectively. Significantly the highest number of filled grain/penicle 235, 233 & 234 were observed in BINAdhan-6 and the lowest 150, 148 & 149 were found in BR-28 in 2002-03, 2003-04 and by pooled, respectively. Significant difference was observed in 1000-seeds weight and it was the highest 23.50 g, 23.07g & 23.29g in BINAdhan-6 and the lowest 21.20g , 21.15g & 21.18 g in BR-28 in 2002-03, 2003-04 and by pooled, respectively. The highest grain yield 8.0 t/ha, 7.6 t/ha & 7.8 t/ha were obtained from BINAdhan-6 in 2002-03, 2003-04 and by pooled, respectively. BINA (2001) reported the similar results. The highest grain yield in BINAdhan-6 might be due to the cumulative influence of significant increase of number of filled grain/penicle, 1000-seeds weight and numerical increase of number of effective penicle/hill BINA (2001) reported the similar results. The lowest grain yield 5.3 t/ha 5.1 t/ha and 5.2 t\ha were found in BR-28 in 2002-03, 2003-04 and by pooled, respectively. Significantly the highest straw yield 8.30 t/ha, 8.7 t/ha and 8.39 t/ha were found in BINAdhan-6 and the lowest 6.50 t/ha, 6.30 t/ha and 6.40 t/ha were found in BR-28 in 2002-03, 2003-04 and by pooled, respectively. Significantly, the longest duration 160 days, 158 days and 159 days were observed in BINAdhan-6 and the lowest duration 129 days, 127 days and 128 days were observed in BR-28 in 2002-03, 2003-04 and by pooled, respectively. Although, the longest duration was observed in BINAdhan-6 but it was harvested before succeeding crop plantation.

Economics

Agro-economic performance of rice - pulses as (vegetable + fodder)- rice cropping pattern under this study is presented in table 4a, 4b, 5a, 5b, 6a and 6b . Among the different monsoon rice, varieties, the highest gross return of Tk. 58200 /ha, Tk. 53600 /ha and Tk. 55900 /ha,; net return of Tk. 43350 /ha, Tka 38450 /ha & Tk. 40900/ha and Benefit Cost Ratio (BCR) 3.92, 3.54 & 3.73 were found in BINAdhan-4 in 2002-03, 2003-04 and by pooled, respectively. The lowest gross return of Tk. 44200/ha, Tk. 43370 /ha & Tk. 43840 /ha; net return of Tk. 29800/ha Tk 28870k/ha & Tk. 29390 /ha and BCR 3.10, 2.99 & 3.03 were found in BR-39 in 2002-03, 2003-04 and by pooled, respectively (Table 4a and 4b).

Among the different relay pulses as vegetable + fodder, field pea produced the highest gross return of Tk.50400/ha, Tk. 41750/ha and Tk. 46075 /ha; net return of Tk.38456/ha, Tk. 30840/ha and Tk. 34648/ha, and BCR 4.22, 3.83 & 4.03 in 2002-03, 2003-04 and by pooled, respectively .The lowest gross return of Tk. 25350/ha, Tk. 17150 /ha and Tk. 21250 /ha; net return of Tk. 17284/ha Tk 9550/ha & Tk. 13417 /ha and BCR 3.14, 2.26 & 2.70 were found in chickpea in 2002-03, 2003-04 and by pooled, respectively (Table 5a and 5b).

In the different spring rice, the highest gross return of Tk. 88470 /ha, Tk. 84300 /ha & Tk. 86390 /ha,; net return of Tk. 67980 /ha, Tk. 64010 /ha & Tk. 66000 /ha and BCR 4.32, 4.15 & 4.24 were found in BINAdhan-6 in 2002-03, 2003-04 and by pooled, respectively. The lowest gross return of Tk. 59500/ha, Tk. 57300 /ha & Tk. 58400 /ha; net return of Tk. 39700/ha Tk 37600/ha & Tk. 38650 /ha and benefit cost ratio 3.01, 2.91 & 2.96 were found in BR-28 in 2002-03, 2003-04 and by pooled, respectively (Table 6a and 6b).

In this study, BINAdhan-4 - field pea (as vegetable + fodder)-BINAdhan-6, cropping pattern combindly (3 crops) produced the highest net return of Tk. 141540 /ha/year i.e. equivalent to $ 2212/ha/year (1$ = 64 Tk.).

Conclusion

From, the results of this study it might be concluded that BINAdhan-4- field pea (as vegetable + fodder) - BINAdhan-6 is suitable for the better adjustment of cropping pattern and also more profitable cropping pattern for resource poor-farmers in Bangladesh.

Table-1(a). Performance of different monsoon rice varieties on the yield contributing characters

Treatment	Plant height (cm)			No. of effective penicle/hill			No. of filled grain/penicle			1000-seeds weight(g)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
BR-32	105.25	104.0	104.63	8	8	8	99 b	97b	98b	21.24c	21.20c	21.22c
BR-39	99.70	98.0	98.85	7	7	7	84 c	82c	83c	22.18b	22.10b	22.14b
B.dhan-4	109.63	107.0	108.50	8	8	8	108a	109a	108a	22.85a	22.83a	22.84a
CV(%)	4.45	4.23	5.23	5.60	7.15	6.40	4.76	3.09	4.05	2.32	2.40	2.20
LSD	10.57	9.41	10.90	3.83	4.30	4.20	9.47	6.67	6.80	0.41	0.20	0.32

Table -1(b) Performance of different monsoon rice varieties on the yield contributing characters

Treatment	Grain yield (t/ha)			Straw yield (t/ha)			Duration (days)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
BR-32	4.50b	4.37b	4.44b	5.17b	5.07b	5.12b	128	130	129
BR-39	3.97c	3.90c	3.94c	4.50c	4.37c	4.44c	121	125	123
Binadhan-4	5.20a	4.80a	5.00a	6.20a	5.60a	5.90a	122	126	124
CV(%)	5.16	4.23	4.50	2.90	5.9	4.80	7.0	1.83	2.10
LSD	0.50	0.42	0..45	0.39	0.50	0.45	8.0	6.23	7.20

Table-2(a). Performance of different relay pulses as vegetable and fodder

Treatment	1st harvest of vegetable (DAE)			Last harvest of vegetable(days)			Vegetable harvesting duration (days)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
Lathyrus	52b	54a	53.0b	102	100	101.0	50	46a	48
Chickpea	56a	59a	57.5a	100	95	97.5	44	36b	40
Field pea	52b	54b	53.0b	102	100	101.0	50	46a	48
CV(%)	3.08	3.57	4.08	3.60	2.69	3.95	5.51	6.54	6.70
LSD	1.31	1.40	2.30	2.31	6.00	5.90	6.00	3.15	8.00

Table -2(b) . Performance of different relay pulses as vegetable and fodder

Treatment	Frequency of vegetable harvesting			Total vegetable wt. (t/ha)			Total fodder wt. (t/ha)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
Lathyrus	7 ab	6 ab	6.5ab	2.70b	2.20b	2.45b	17.70 b	15.80b	16.75 b
Chickpea	6 b	5 b	5.5b	1.80c	1.20c	1.50c	7.50c	5.50c	6.50c
Field pea	8 a	7 a	7.5a	3.60a	2.90a	3.25a	19.20 a	17.00a	18.10 a

CV(%)	8.25	7.25	7.48	12.05	4.76	8.65	3.32	4.45	5.10
LSD	1.31	1.30	1.20	0.74	0.23	0.30	1.11	1.18	1.10

Table-3(a). Performance of different spring rice varieties

Treatment	Plant height (cm)			No of effective penicle/hill			No. of filled grain/penicle			1000-seeds weight(g)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	043-04	Pooled	02-03	03-04	Pooled
BR-28	90.30	88.20	89.25	12	12	12	150c	148c	149.00c	21.20c	21.15c	21.18c
BR-29	101.50	100.30	100.90	13	13	13	180b	177b	178.50b	22.00b	21.90b	21.95b
B. dhan-6	103.20	102.10	102.65	14	14	14	235a	233a	234.00a	23.50a	23.07a	23.29a
CV(%)	11.78	6.46	9.20	5.94	3.78	4.90	4.53	5.9	5.10	2.94	2.26	2.90
LSD	26.18	14.16	15.20	2.76	2.48	3.20	6.54	24.90	18.00	0.47	0.12	0.15

Table -3(b) Performance of different spring rice varieties

Treatment	Grain yield (t/ha)			Straw yield (t/ha)			Duration (days)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
BR-28	5.30c	5.10c	5.20c	6.50c	6.30c	6.40c	129c	127c	128c
BR-29	6.80b	6.50b	6.65b	7.50b	7.25b	7.38b	150b	148b	149b
B. dhan-6	8.00a	7.60a	7.80a	8.47a	8.30a	8.39a	160a	158a	159a
CV(%)	4.60b	4.39	4.50	3.80	4.95	4.60	4.28	5.33	4.65
LSD	0.12	0.34	0.30	0.70	0.65	0.30	4.24	2.63	6.60

Table-4(a). Agro-economic performance of different monsoon rice varieties

Treatment	Grain yield (t/ha)			Straw yield (t/ha)			Cost of production (Tk/ha)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
BR-32	4.50	4.37	4.44	5.17	5.07	5.12	14500	14850	14675
BR-39	3.97	3.90	3.94	4.50	4.37	4.44	14400	14500	14450
Binadhan-4	5.20	4.80	5.00	6.20	5.60	5.90	14850	15150	15000

Table -4(b) Agro-economic performance of different monsoon rice varieties

Treatment	Gross return (Tk/ha)			Net return (Tk/ha)			Benefit cost ration (BCR)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
BR-32	50170	48770	49520	35670	33920	34845	3.46	3.28	3.37

BR-39	44200	43370	43840	29800	28870	29390	3.10	2.99	3.03
Binadhan-4	58200	53600	55900	43350	38450	40900	3.92	3.54	3.73

Price: Ploughing = Tk. 750/ha/plough
Paddy = Tk. 10000/ton Human labour = Tk. 70/head/day
Straw= Tk. 1000/ton Urea = Tk. 6.0 /kg; TSP= Tk. 15.0/kg; MP= Tk. 9.0/kg

Table-5(a). Agro-economic performance of different relay pulses as vegetable and fodder

Treatment	Vegetable wt. (t/ha)			Fodder wt. (t/ha)			Cost of production (Tk/ha)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
Lathyrus	2.70	2.20	2.45	17.70	15.70	16.70	10384	9800	10092
Chickpea	1.80	1.20	1.50	7.50	5.50	6.50	8066	7600	7833
Field pea	3.60	2.90	3.25	19.20	17.00	18.10	11944	10910	11427

Table5(b). Agro-economic performance of different relay pulses as vegetable and fodder

Treatment	Gross return (Tk/ha)			Net return (Tk/ha)			BCR		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
Lathyrus	39300	33300	36300	28952	23500	262008	3.79	3.40	3.60
Chickpea	25350	17150	21250	17284	9550	13417	3.14	2.26	2.70
Field pea	50400	41750	46075	38456	30840	34648	4.22	3.83	4.03

Price :

Pulses	Vegetable	Fodder
Lathyrus	8000 Tk/ton	1000 Tk/ton
Chickpea	12000 Tk/ton	500 Tk/ton
Field pea	10000 Tk/ton	750 Tk/ton

Table-6(a). Agro-economic performance of different spring rice varieties

Treatment	Grain yield (t/ha)			Straw yield (t/ha)			Cost of production (Tk/ha)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
BR-28	5.30	5.10	5.20	6.50	6.30	6.40	19800	19700	19750
BR-29	6.80	6.50	6.65	7.50	7.25	7.38	20100	20000	20050
Binadhan-6	8.00	7.60	7.80	8.47	8.30	8.39	20490	20240	20390

Table -6(b) Agro-economic performance of different spring rice varieties

Treatment	Gross return (Tk/ha)			Net return (Tk/ha)			Benefit cost ration (BCR)		
	02-03	03-04	Pooled	02-03	03-04	Pooled	02-03	03-04	Pooled
BR-28	59500	57300	58400	39700	37600	38650	3.01	2.91	2.96
BR-29	75500	72250	73800	55400	52250	53750	3.76	3.61	3.68
Binadhan-6	88470	84300	86390	67980	64010	66000	4.32	4.15	4.24

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