PARTICIPATORY AGRO-ECOSYSTEM ANALYSIS AND IDENTIFICATION OF PROBLEMS OF A VILLAGE IN BUNDELKHAND REGION

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Introduction

The opportunity for learning interdisciplinary research, must be developed to create interactive and interdisciplinary research. In this context National Academy of Agricultural Research Management (NAARM) trains young scientist recruits through a training program called Foundation Course for Agricultural Research Service (FOCARS). One month Field Experience Training (FET) is an inbuilt program, where young scientists work in village and learn Participatory Rural Appraisal (PRA) methods. These scientists are already exposed to PRA techniques through class-room teaching and work exercises, in village they facilitate the process of appraisal, farmers do the appraisal themselves in the form of self drawn pictures and diagrams (Mettrick and Wessel, 1986, Conway, 1987). The objectives of the present study are:

1. Training young recruits of Agricultural Research Service in PRA methods.
2. Training local stakeholders (farmers, NGO, key informants) in participatory data collection procedures.
3. Understanding farming system and identifying system problems and solutions thereof.

The present study was conducted during October-November, 2000 in a village called '*Chirula*' which is situated in Bundelkhand region of Madhya Pradesh state, India. The system tools and methods were used for identifying indeginous natural resource types, relationships and key decision making systems in the village.

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Methodologies

As the study was completely participatory and interdisciplinary, the following procedures were used to invoke participation and data collection.

Agro-ecosystem mapping

The farmers identified resources and location, their utility and decision system (Hoque, 1984). They draw a map on the ground and later translate it to the drawing sheet. The farmers discussed various decision making systems while constructing the maps, and other useful information about the village was also collected while preparing the agroecosystem map.

Village Transect

Three transect walks through the village were conducted along with villagers and discussions during the walk helped to identify indeginous natural resource types, elements of systems (Conway 1985, Mettrick, 1993) to find contrast in various niches and reasons of contrast.

Problem Analysis

Agro ecosystem analysis helped to carry out problem analysis. The problems in the system were identified, analysed (Mettrick, 1993) and ranked on the basis of various criteria identified by the farmers and the intensity of yield loss (Sabarathnam and Vennila, 1996). There was an in depth analysis of the topmost problem in the form of constraint-objective trees constructed after focused group discussions with key stakeholders.

Results

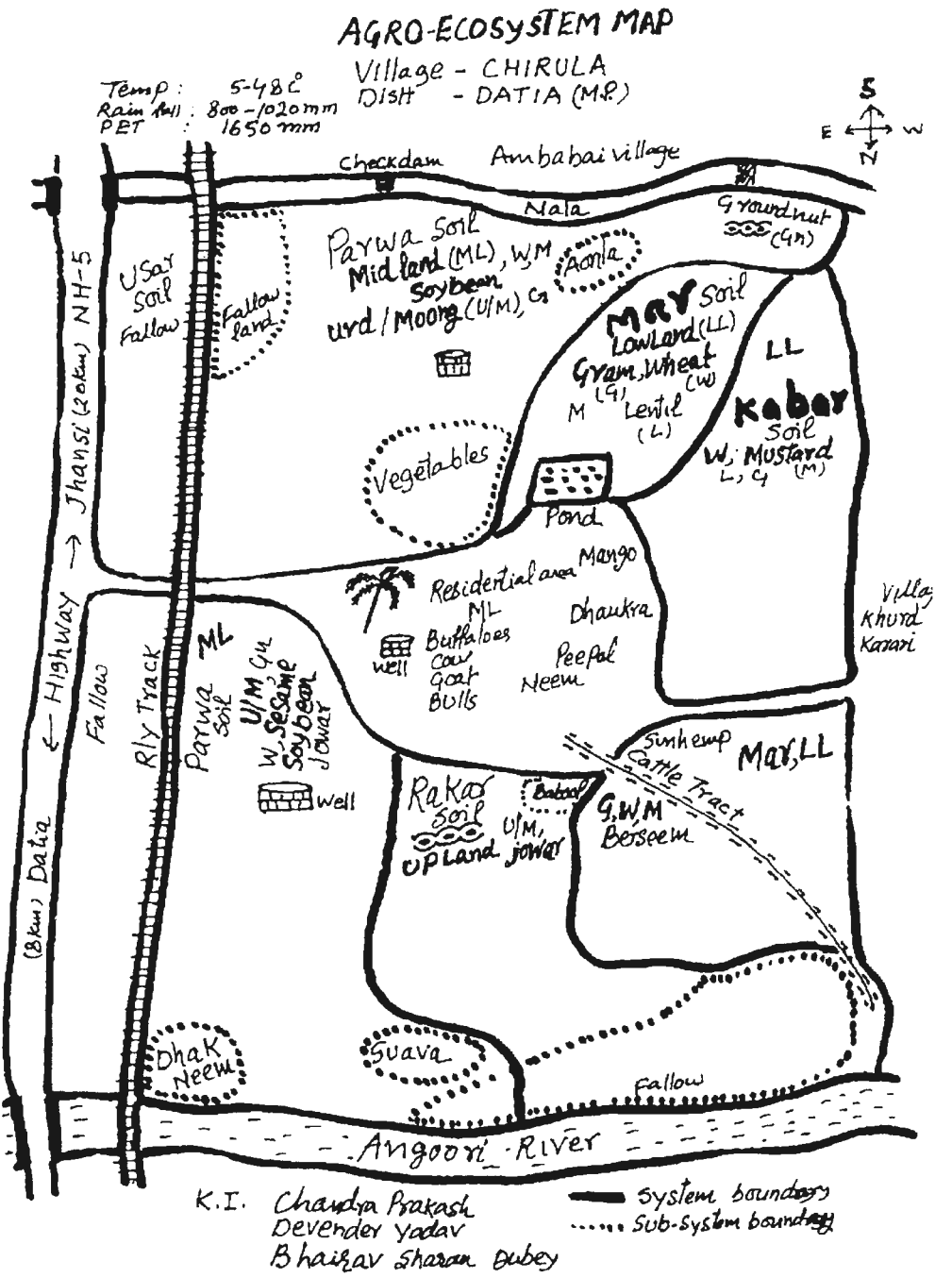
Agro-ecology

The village *' Chirula'* lies in the block Datia of District Datia in Madhya Pradesh, the area is part of larger *'Bundelkhand'*, which consist of 13 districts of Uttar Pradesh and Madhya Pradesh (23° 8' – 26° 30' N latitude, 78°11' – 81° 30' E longitude). The village represents a tropical semi arid

climate where temperature range is 5-48C°, the mean annual rainfall ranges from 800 to 1020 mm (July-Sept during monsoon), and the mean annual potential evapo-transpiration is 1656 mm, which is more than the rainfall received. Out of the 224 farm households, 95% are engaged in agricultural or allied activities, as per their own criteria ,18% are rich (land >15 acre), 39% medium (land 5-14 acre), 32% medium (land 1.5 acres) and 11% are landless poor. The land availability per household is 2.66 ha, and per person is 0.26 ha.

Land utilization pattern

Total available land is 598 ha, 61.3% of this is Net Sown Area (NSA), which is a little less than NSA of District Datia (63.2%). Irrigation is well developed in the village and the main sources of irrigation are wells, *Angoori* river, check dams, all these sources account for irrigating 60.7% of NSA or 37.1% of total available area, which is higher than Datia Block (21,7%). The significant amount of land (38.6%) fall in the category of other uses (pasture, forest culturable waste, fallow), this is line with district, where 36.7% land is put under the category called 'other uses' .Various soil types exhibited in the village determine land use pattern. These soil types locally known as *Rakar*, *Parwa* (red soils) *Kabar* and *Mar* (black soils types). The R*akar* occurring in uplands is reddish brownish, shallow gravel, poor in nutrients and water retention capacity. Groundnut is major crop on this rakar soil and the other crops are urad, moong and jowar. The *Parwa* occurring in medium lands is gray to brownish, fine textured, loam to sandy loam. Almost all crops are grown on *Parwa* soil, but the main crops are soybean, urd, moong and sesame. These soils gives good yield with proper fertilizer application and irrigation. The *Kabar* soil occur in low land and is black in color, clayey, coarse grain, medium depth, and the soils develop cracks after drying. The *Mar* soil is black, fine in texture, alkaline in nature, shows swelling and shrinking on wetting and drying respectively, this soil occurs in low lands and has higher water retention capacity. Farmers therefore use this soil alongwith Kabar for cultivation of rabi crops, mainly wheat, gram, mustard.


AGRO-ECOSYSTEM MAP
Village - CHIRULA
Dist - DATIA (M.P.)
Temp : 5-48°C
Rain fall : 800-1020 mm
PET : 1650 mm
S
E
W
N
Checkdam
Ambabai village
Nala
Groundnut (Gn)
Parwa Soil
Mid land (ML), W,M
Soybean
Urd / Moong (U/M), Cs
Aonla
Usar Soil
Fallow
Fallow land
Mar Soil
Low Land (LL)
Gram, Wheat (W)
M (G), Lentil (L)
LL
Kabar Soil
W, Mustard (M)
L, G
Vegetables
Pond
Residential area
Mango
Dhaukra
Peepal
Neem
Buffaloes
Cow
Goat
Bulls
well
Village Khurd Karari
Highway → Jhansi (20km) NH-5
(8km) Datia
Fallow
Rly Track
ML
Parwa Soil
U/M, Gn
W, Sesame
Soybean
Jowar
well
Sunhemp
Cattle Tract
Mar, LL
Rakar Soil
Upland
U/M, Jowar
Babool
G, W, M
Berseem
Dhak
Neem
Suava
Fallow
Angoori River
K.I. Chandra Prakash
Devender Yadav
Bhairav Sharan Dubey
System boundary
Sub-System boundary

System properties

Crop production system

Wheat (WH-147), urd (T-15) , and moong (K-851), groundnut (Jhumku), gram (Avrodhi) and mustard (Pusa varuna) are the major crops of the village. These crops are grown on 62% 30%, 22%, 15% and 7% of NSA respectively. The village exhibits more area under *rabi* crops than *kharif* crops. In decreasing order of importance, the *rabi* crops are (area under cultivation) wheat, gram, mustard, fodder (*Berseem*), barley, lentil, linseed; while *kharif* crops are urd, moong, groundnut, soybean, sunhemp, sesame, maize and jowar. The comparative figures of land under cultivation is given in the table.

Crops	Village Chirula % of Net Sown Area	District Datia % of Net Sown Area
Cereals	69.5	63.5
Pulses	70.0	41.2
Oilseeds	44.4	09.9
Fodder	07.3	0.84

The Cropping Intensity (C.I) of the village is 181%, which is much higher than the district (105%). This can be owed partly due to irrigation and partly due to the attitude of people. Farmers have their own criteria and prefer some crops over others. They prefer gram, wheat, urd, moong, groundnut, sesame and fodder crops still a last choice and is grown on 5% of NSA. As per their preference, farmers left the cultivation of cotton, red gram, sunflower, rabi sorghum and lerma wheat, they also did not prefer agroforestry system except aonla (*Embilica officinalis*) and guava (*Psidium gujava*) orchards on a very small scale. To make effective use of rakar soils, groundnut is the first choice, it gives more income and gives groundnut cake for livestock. The only draw back is higher cost of seeds and fungal infection of seeds. Cropping system is also not free of problems. The most important of them are tikka desease in groundnut, white grabs, tertmites, leaf roller,weeds and labour shortage are serious problems of crop production. The important weeds identified by the farmers are gunara (*Panicum antidotale*) wild rice (*Leersia hexandra*) Pammar (*Cassia tora*), *Parthenium hysterphorus* and *Lantana amara*.

Livestock production system

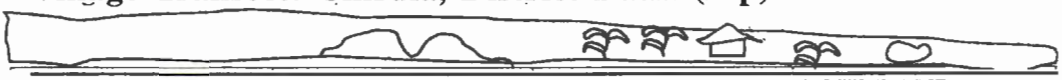
Unlike the general feature of Bundelkhand, the village has more buffaloes than cattle (buffalo to cattle ratio – 2). However Adult Cattle Unit (where 1 goat or sheep equal to 1/5 of cattle) is almost at par with Datia block (*Chirula* village 134 ACU/100ha, Datia block 146 ACU/100 ha). But the number of Animal/irrigated area is 3.5 in this village, while it is 7.3 in Datia block. With respect to the proportion of buffalo and cattle, village Chirula (buffaloes 0.66/ha, cattle 0.33/ha) expresses pattern of Datia block where buffaloes are double the cattle (buffaloes 1.5ha, cattle 0.8/ha). In general, in Bundelkhand, cattle are more than the buffaloes, in 1976 the buffaloe to cattle ratio was 0.34, which increased to 0.36 in 1985. The grazing pressure (total ACU/ grazing area) and grazing intensity (grazing land available per ACU) in the village is 3.94 and 0.25 respectively, while in district Datia these figures are 5.5 and 0.18 respectively. Various diseases like Foot and Mouth Disease (FMD), Hemorrhagic septicemia are major diseases. The problem in livestock production system is low productivity and infertility of animals. Farmers keep more buffaloes than cattle. The farmers have also tried the jersey cow, but have been unsuccessful, because the harsh climate does not suit the animal. Another major problem in livestock production is '*Annapratha*' the farmers leave their animals for Free Range Grazing which is an obstacle in crop production system.

Niches in the system

Though the village depicts plain topography, variations occur at a minor level which are associated with specific features. Upland, medium land and low land have been identified as various niches in the system associated with respective characteristics (see village transect). In uplands rakar soil is a major soil type where farmers mainly grow groundnut. These lands have trees like *babbol* (*Acacia nilotica*), *neem* (*Azadirachta indica*), *dhak* (*Butea monosperma*) and *ber* (*Zizyphus jujuba*). The uplands are mainly used as pasture and offer opportunities for devloping agroforestry based pastures. In medium lands major soil type is parwa, and it is a major crop production center, tree like *dhaukra or kardhai* (*Anogeissus pandula*) is a major commodity for timber and firewood. This tree is known as best firewood, which can fire even when it is wet, but nowadays it is phasing out from the agroecosystem and needs attention. The major problem in medium land is

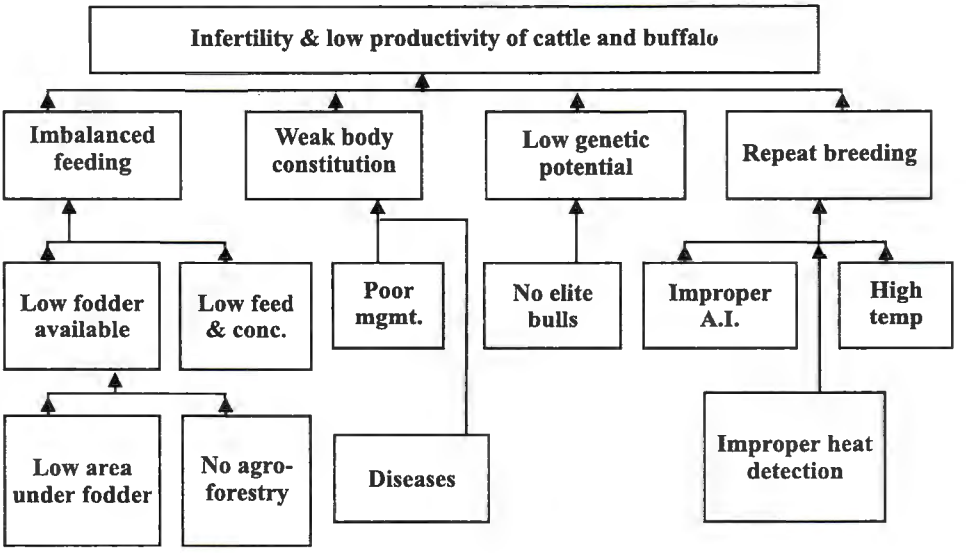
free range grazing of the animals. The low land is another niche and is characterized by kabar and mar soil type, which is used for limited crop production during rabi season.

Village Transect: Chirula, District Datia (Mp)

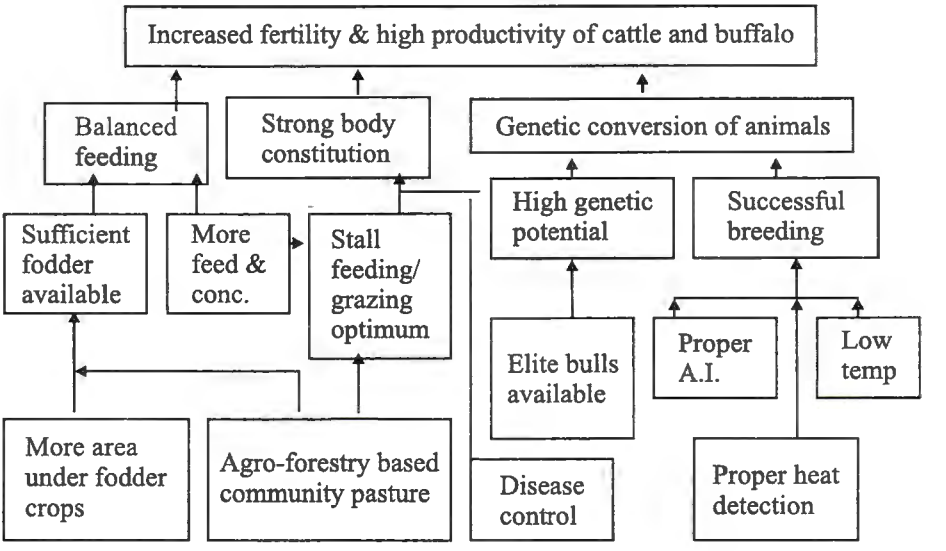


	UPLAND	MEDIUM LAND	LOW LAND	
Soil type	Rakar	Parwa	Mar	Kabar
Soil characteristics	Brownish red, gravel, low water retention	Brownish gray, Brownish gray, loam	Black, fine, water retentive	Black, coarse, water retentive
Major crops	Ground nut, urd, moong, sesame	Urd, moong, sesame, soybean	Wheat, gram, mustard, lentil, sunhemp	Wheat, gram, mustard
Fodder	Natural pasture	Jowar, crop residues	Berseem and crop residues	Crop residues
Trees	Babool, neem, dhak,ber	Aonla, guava, dhaukra, ficus spp, ber, date palm	Dhaukra	
Water source	Seasonal river	Check dam, well	Check dam, well	
Weeds parthenium	-	Pammar, lantana, parthenium	Pammar, gunara, wild rice, lantana	
Animals	Cow, goat	Cow, buffaloes, goat, sheep	-	
Problems	Water scarcity	Stray animal, low cropped area, weeds	Stray animals, less productive animals	
Opportunities	Agroforestry, pasture development	Controlled grazing, increase animal production	Controlled grazing, weed management, increase kharif area	

Constraint Tree of top most problem



Objective Tree for possible solutions



Problem Analysis

While analysis the system properties various researchable and non-researchable problems are identified, the problem ranked in order of their importance, which are as follows.

1. Infertility and low productivity of cattle and buffaloe
2. Water scarcity
3. Pest & diseases in crops
4. Free range grazing of animals (Annapratha)
5. Shortage of Farm implements
6. Wild rice during kharif season.

A participatory indepth study through constraint tree and objective tree analysis of the top most researchable problem revealed various reasons contributing to the problem and find out probable research themes (see constraint tree & objective tree).

Discussion

The village has four types soils. The red soils are affisols and entisols and black soils are vertisols and inceptisols (Hazra, 1981). These soil types determine the local cropping system. Despite a high amount of non-cultivated land, which is at par with district figures, the cropping intensity in the village is much higher than the district. The cropping intensity as such is very low in Bundelkhand region (Tyagi, 1997). The main reason of low intensity in the area is lack of irrigation facilities contributing to less area under rabi cultivation. In village Chirula, higher irrigated area contributed to increase a cropped area in rabi. Analysis of data revealed low acreage under kharif season than rabi season, this requires further investigation, though probable reasons may be:

1. Rakar soil may not be suitable for kharif production
2. Farmers prefer to use rakar soil for natural pasture which flourishes during kharif season
3. *Annapratha* or free range grazing put obstacles in cropping during kharif
4. Farmers discontinued jowar (fodder), redgram, cotton, the kharif crops and suitable alternative is not available

Fodder production is slowly gaining the momentum, and is at present done by growing berseem in rabi at 5% of NSA and by growing jowar during kharif at 2.5% of NSA. During kharif, farmers mainly depend upon natural pastures. In the livestock production sector, the village offers good

opportunity because unlike Bundelkhand region, the trend in the village is to rear buffaloes and (keeping less unproductive cattle) in this region harsh climate is attributed as reason for less production and infertility of cattle. The another positive feature of the village is low animal pressure (1.3/ha) as compared to 2.3 animals/ha in the Datia block, lower grazing pressure and higher grazing intensity than the Datia block as such (ICRA, 1998). The buffaloes to cattle ratio in village is two, while in Bundelkhand, even in administrative blocks of higher number of buffaloes, the ratio varies from 0.35 to 0.68 (ICRA, 1998). Due to the attitude of keeping *desi* buffaloes or *murrah* buffaloes, the number of animals/irrigated area in the village is lower (3.5) than the Datia block (7.3). ICRA, 1998 study finds that keeping the unproductive cattle in more number encourages free range grazing, while keeping a less number of productive animals encourages stall feeding, therefore the curse of *annapratha* could be reduced.

Based on the study, the following recommendations can be made

1. Efforts to increase productivity of animals
2. Increasing the area under kharif cultivation
3. Increasing production efficiency of rakar soils through ber / aonla based community silvi pastures.

For enhancing fertility of animals and increasing productivity of animals, the following research themes are suggested for further investigation and development, which can be taken up on a priority basis.

1. Increase area under irrigated and on irrigated fodder on private lands
2. Develop community fodder production systems in wastelands
3. Genetic conversion of animals

The importance of Participatory Rural Appraisal (PRA) as an analytical tool and as a training tool was realized positively. The information collected in the village is in agreement with various other studies conducted in the past, the study also provided issues of disagreement with earlier studies. The PRA tools helped to make in depth participatory analysis for bringing out new emerging issues of conducting further investigations and make recommendations.

Acknowledgments

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