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Participatory Rural Appraisal Technique for Research Prioritization to Improve Productivity of Rainfed Upland Ecosystem

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WATER TECHNOLOGY CENTRE FOR EASTERN REGION
(Indian Council of Agricultural Research)
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केन्द्रीय बारनी कृषि अनुसंधान संस्थान
Central Research Institute for Dryland Agriculture

Dr. H. P. SINGH
DIRECTOR

MESSAGE

I am extremely happy to learn that Water Technology Centre for Eastern Region (ICAR), Bhubaneswar, is planning to publish a bulletin on 'Participatory Rural Appraisal techniques (PRA) for research prioritization to improve productivity of rainfed upland ecosystem'. Further it is also encouraging to note that the study has been carried out at Arnapurnapur village, Dhenkanal where National Agricultural Technology Project (NATP, RRPS-3) is being implemented.

I had an opportunity to visit that village twice, first on 16.9.2000 with World Bank team and later on 25.8.2001 to attend the farmers' Field day, organized by Water Technology Centre for Eastern Region (ICAR), Bhubaneswar. I appreciate this effort because at this juncture, there is a need for concentrated efforts to study the problems of farming community and solving them through participatory technology development for improving sustainability of farming system in order to meet the challenge to augment food production. In this context, participatory rural appraisal techniques (PRA) have proved as very effective tools to provide understanding of the technology adoption profile of the farming community and to get the first hand information about the living conditions, needs, resources, priorities, problems and livelihood situations. This in turn would guide in identifying appropriate technology dissemination process and matching needs for suitable infrastructure for input/credit supply and marketing as well as the required linkages among various players//stake holders.

I believe that this PRA exercise, done by Water Technology Centre for Eastern Region (ICAR), Bhubaneswar, will be helpful to characterise natural resources, prioritize research and bridge the gap between research and extension for appropriate technology development for dissemination. I am also convinced that considering its success it will also become a model for other Institutions to follow.

I wish the effort a grand success.

28/8/01

(H.P. SINGH)

PREFACE

Current projections for global population growth represent a massive challenge to the agricultural sector which not only supplies food but also engage large rural population to make a living. Alarming fact is that India is likely to touch, 1,225 million human and 600 million live-stock population by 2015 AD, necessitating 275 million tons of food grains, 1000 million tons of green fodder and 235 million cubic meter of fuel wood against out current supplying capacity of 200 million tons of food grains, 513 million tons of green fodder and 40 million cubic meter of fuel wood. Situation is now very challenging. At this juncture, we have to utilize each and every part of land up to its potential by bringing the output of research to the real world, i.e., farmer's field. Main thrust should be given on critical assessment of the available resources and technologies in terms of local farmers' need and socio-economic situations. In this aspect participatory rural appraisal technique (PRA) may prove as an effective means to study the basic natural resources and their optimum utilization. In the present research bulletin, PRA study has been carried out to characterize natural resources and prioritize research to improve productivity of upland rice ecosystem through a NATP project (RRPS - 3), funded by World Bank. The study has been carried out at Arnapurnapur village of Dhenkanal district, Orissa, which is mainly rainfed and mono-cropped.

We are highly obliged and thankful to Honorable Director General, ICAR for his immense interest and support in executing National Agricultural Technology Project (NATP). Authors are extremely thankful to World Bank authority for providing fund to carry out the study through NATP. The authors are extremely thankful to Dr. J. S. Samra, D.D.G.(NRM), I.C.A.R., for his constant interest to characterize natural resources through PRA. We take this opportunity to extend our esteemed sense of gratitude to Collector and DDA, Dhenkanal, B.D.O., Kamakhyanager, OIC, Central Rubber Board, K.V.K., Dhenkanal for providing necessary information to carry out the study. Authors' sincere thanks are due to villagers of Arnapurnapur for their active participation during study. Thanks are due to Dr. R.S. Tripathy, Lead P.I. and Director of research, IGKV,Raipur for his moral support and constant encourgement for this PRA study.

Authors' are also thankful to Dr. C. Satapathy, Dean, (Extension), O.U.A.T., Bhubaneswar for having taken pains to go though the manuscript critically. Thanks are due to all scientists, staff members of W.T.C.E.R. for their moral support and help rendered during study. We also thank IMD, Pune for supplying meteorological data for the study.

(AUTHORS)

INTRODUCTION

With the approach of new millenium, the pressure on land has increased tremendously to obtain food, nutrition and environmental security. At this juncture we have to utilize each and every part of land up to its potential by bringing the output of research to the real agricultural world, i.e., farmers' field. Main thrust should be given on critical assessment of the available technologies and their gaps to disseminate to the farmers' field. Thus there is a need for concerted efforts to study the problems and solving these problems through research and social motivation for improving sustainability of cropping system and for meeting the challenges to augment food production from our limited land. In this regard, participatory rural appraisal technique (PRA) is one of the most effective tools which can be utilized to understand the technology adoption profile by the farmers and to get the first hand information about their needs, resources available, priorities, problems and prospects. This process will help to understand technology dissemination process, rural developmental activities, linkage mechanism existing among research, training and extension, credit and input supply system etc. The PRA will also help to provide an opportunity to gain an insight and appreciation about the indigenous technologies of the farmers and the ways and means to build on them to generate appropriate technologies. In this report an attempt has been made to study and analyse the agricultural problems and prospects in Arnapurnapur village of Dhenkanal district, Orissa with reference to the local resources base, agro-ecology and technology adoption for upland crop diversification.

MATERIALS AND METHODS

Data recording and survey procedure:

The data recording and survey for PRA were carried out using 6 following important procedures.

(i) ***On the spot visualization:*** On differant aspects of village resource base like crops and genotypes practised, animal husbandry, fisheries etc.

(ii) ***Secondary data source from :*** (a) Deputy Director of Agriculture Office, Dhenkanal (b) Katni Gram Panchayet (c) Kamakhsyanagar Block Office (d) CRRI KVK, Dhenkanal (e) Meteorological observatory of Central Rubber Board Office, Dhenkanal

(iii) ***Semi-structural interview :*** In this method, a set of questions were prepared before hand while discussing with various organizations for collection of information. The questions arouse during course of discussion were also taken care of.

(iv) ***Key informants' interview:*** The constraints, adoption gaps and problems related to upland agricultural development were analysed first on the basis of key informants' information.

(v) ***Personal or group Interview:*** Information on daily routine, livelihood, preferential ranking were also collected through personal and group interviews.

(vi) ***Cartographic representation or mapping:*** The maps like agro-ecological map, social map, transect, technology map were drawn with the active participation and help of the villagers to know the agro-ecological and social resources, social stratification, technology adopted etc. in the village.

The reason for low and unstable yield of upland and the problem for non-adoption of double cropping in upland were studied using Rank Based Quotient (RBQ),

$$RBQ = \sum_{i=1}^{n} \frac{F_i (n+1-i) \times 100}{N \times n}$$

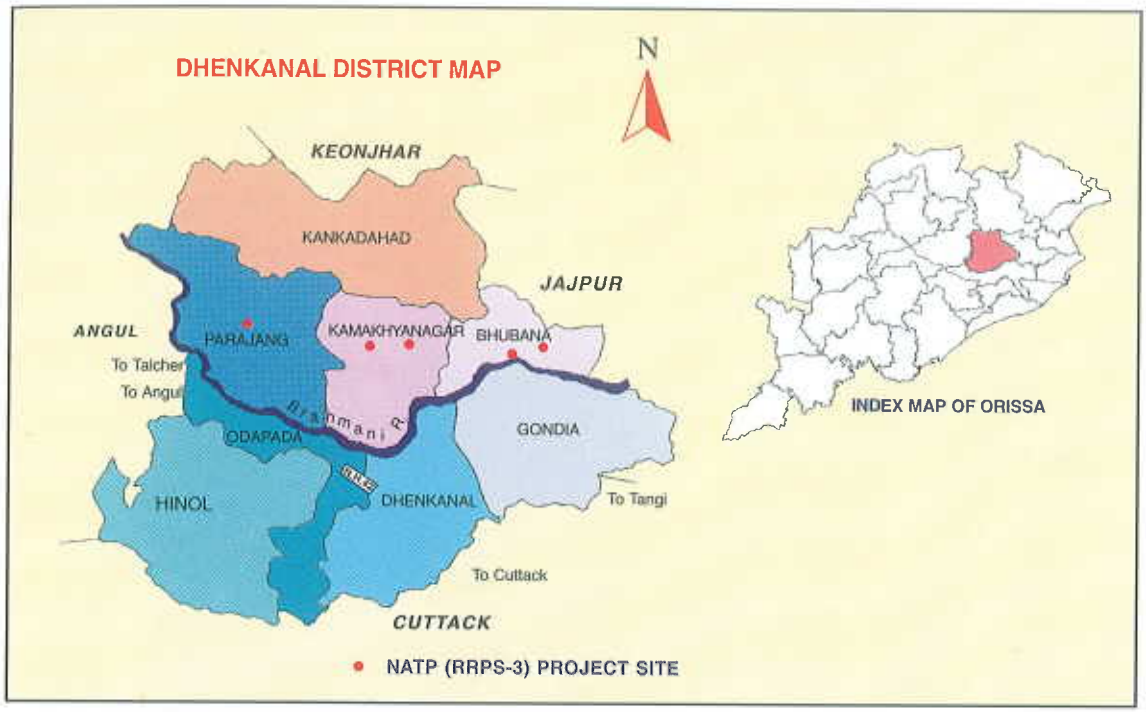
F_i = Frequency of key informants for the i^{th} rank
n = Number of rank
N = Number of key informants

RESULTS AND DISCUSSION

Basic information about the district:

According to the NARP classification of agroclimatic zones (1979), the Dhenkanal district comes under the Mid-central Table Land Agroclimatic Zone of Orissa. Physiographically, the district is located in the middle of the central table land zone which rises from east to west and has average elevation of 300 meters from mean sea level. The zone is generally flat with undulating and folded topography, surrounded by hillocks. The district is demarcated on the north by Sundargarh and Keonjhar districts and on the south by Cuttack, Puri and West by Angul and east by Jajpur district. In general, the climate of the district is hot and sub-humid. The mean maximum temperature occurs in the month of May with the value being 46.2 °C and the mean minimum temperature occurs in December with the value being 9.0 °C. The mean annual rainfall of the district is around 1400 mm.

The total geographical and cultivated area of the district are 43,30,88 ha and 20,56,07 ha, respectively, out of which 50 % is under upland (10,36,96 ha). The cropping intensity of the district is only 116 %. The study indicates that during *kharif*, 96 % of the area is dominated by paddy and rest 4 % is under different crops like groundnut, maize, blackgram, greengram, sesamum , jute etc. During *kharif* season, only 44,833 ha area is irrigated and 27,331 ha area is under irrigation during *rabi* season. The major irrigation



sources are medium irrigation project (18,315 ha), minor irrigation project (18,200 ha), lift irrigation (7037 ha) and dug well (28,612 ha). The main crops grown during *rabi* are paddy, vegetables, green gram, black gram, groundnut, sunflower, mustard etc.

Study Village:

The PRA survey was carried out in the Arnapurnapur village of Kamakhyanagar block which is situated in the western part of the Dhenkanal, Orissa. The total population of the village (NATP village) according to 1991 census was 107 with a sex ratio of 1:1 (Fig. 1), out of them, 27 were children (below 12 years age). There were 175 number of animals in the village, of the total animals, 51 per cent were milch cows, and 35 per cent were bullocks and 14 per cent were young stock (Fig. 2). It was found that per family, on an average of Rs. 4355, Rs. 4837 and Rs. 5000 were borrowed from the Regional Rural Bank, Co-operative Bank and Private money lenders, respectively (Fig. 3). Maximum number of farmers had borrowed money from organized sector, only one farmer borrowed from private source. This indicated that farmers were aware of developmental activities in agriculture. There were 31 farm families in the village, out of which 67 per cent households were small farmers, 13 per cent were marginal farmers and only 20 per cent were large farmers (Fig. 4). The total assets of the households were also studied including land, buildings, livestock, implements, hand tools, durable household good and others.

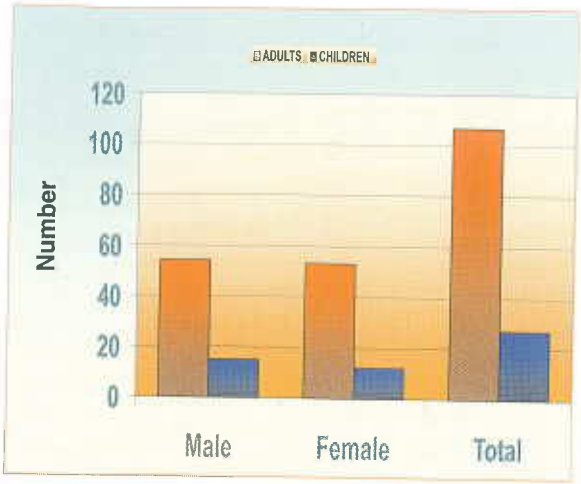


Fig. (1) Sex wise popultion of the village

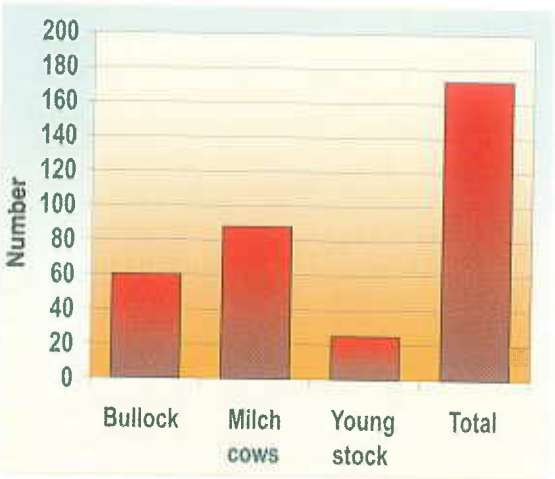


Fig. (2) Livestock population of the village

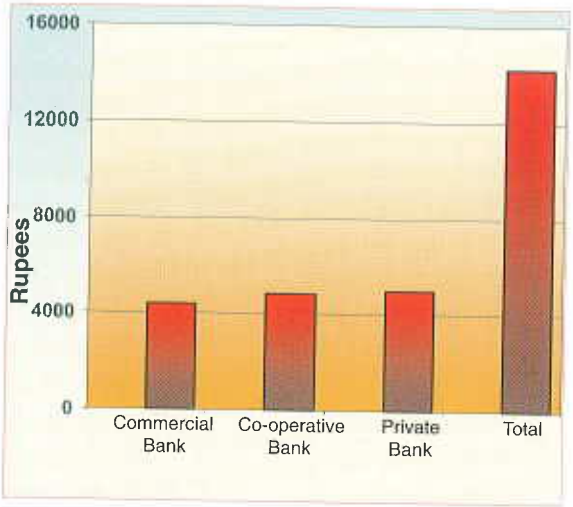


Fig. (3)Average borrowings per household

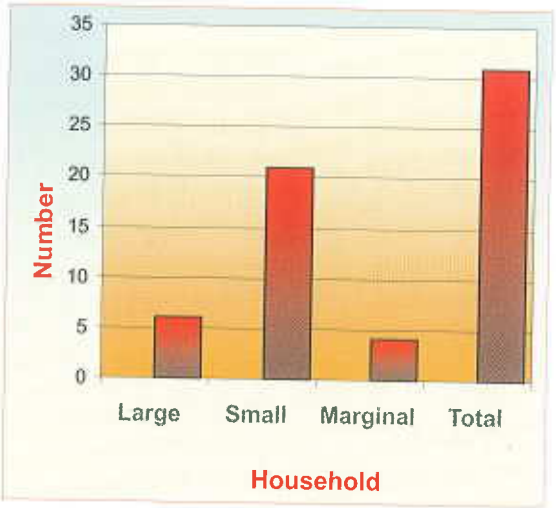


Fig. (4) Distribution of household in the village

Majority of farmers are having their own implements and farm machinery (plough, sickle, sprayer,spade, khurpi) and almost all farmers are having own bicycle.

The total cultivated area of the village was 95 ha. Among these, 90 ha were under monocrop, mainly paddy and 5 ha were under double crop. In lowland area, where irrigation facilities existed, they grew sugarcane with help from local sugar factory. Pulses comprising green gram, horsegram, blackgram and vegetables constituted very less area during *rabi* season. Few farmers had cashew orchard. The existing cropping pattern of the village before starting of the interventions by Water Technology Centre for Eastern Region (I.C.A.R.), Bhubaneswar (through NATP project) is given in table 1.

Scientists and Villagers participation in PRA activities

The existing natural resources of the village were thoroughly analysed utilizing PRA tools with special reference to the local resources base, agro-ecology, technology adoption and change in agricultural sector for improvement of the socio- economic status of the villagers. The different PRA tools used are discussed below.

Women farmers preparing social map of their village

(1) Transects :

Transects are observatory walks or tracks across the country side and fields in any given area, village or watershed. It is helpful to assess the (a) physical features such as topography, hydrology, soil types, (b) locally evolved technologies and management systems which include traditional ITK's (indigenous technical

knowledges) that farmers have been using, (c) crops and agriculture where land use, cropping practices and patterns, productivity etc. are studied (d) local vegetation which include not only prominent tree species in the area but also other local vegetation and its uses particularly medicinal plants and fodders. The transect of the village has been done from east to west and information are given in table 2.

Natural water harvesting pond -a big resource in the village

(2) Social map:

The social map represents the social structure, social institution, neighbourhood pattern, occupation, religion, value system etc. those exists in the village. The social map of the village is depicted in diagramme 1 and the social resources of the village is given in table 3.

The study reveals that all the households of the village are actively involved in agriculture. The land less poor mainly earn through labour wages. Majority of the houses in the village are 'Katcha' which are arranged in a linear fashion on either side of the road. Most of the houses have cattle yard in the front and small backyard with a kitchen garden. In the backyard some farmers are having open space to stack straw after paddy threshing.

Mostly nuclear family is prevalent in the village. It has two panchayat members who look after the development works of the village. One primary school managed by the state government is located in the village. Village has two grocery shops and one anganwadi. Regarding marriage, mostly arranged marriage is practised in the village. Dowry system also prevails in this village. Most of the villagers value to respect elders, they also value money, self esteem, land, and physical well being. There is a co-operation on agricultural practices, sharing of agricultural inputs and outputs etc. Occasionally there are some minor conflicts among villagers.

The most important festival of this village are *'Raja', 'Maha shiva Ratri' 'Dusserah', 'Khudu Purnima', 'Dol purnima',Laxmi Puja,* which are the main occasions for social mingling and sharing blends of happiness. Social evils like chewing of tobacco, alcoholism,

Table 1: Existing cropping pattern of the village before starting of the project

NAME OF FARMER	AGE	OCCUPATION	CROPS TILL 1999 KHARIF	CROPS TILL 1998 RABI	FARMING EXPERIENCE
1.Debakar Behera	48	Agriculture	Paddy, Millet	Sugarcane	25 years
2.Pradeep Samal	35	- do -	Paddy, Moong, Chilli	Sugarcane, Groundnut	10 years
3.Sibaram Sahoo	38	- do -	Paddy	Sugarcane, Cucumber	25 years
4.Krushna sahoo	40	- do -	Paddy	Sugarcane	22 years
5.Purandar Khatua	50	- do -	Paddy, Chilli	——	40 years
6.Kasinath Samal	32	- do -	Paddy, Millet	Sugarcane, Cucumber	20 years
7.Prabhakar Khatua	35	- do -	Paddy		20 years
8.Gokulananda Mahabhoi	58	- do -	Paddy	——	35 years
9.Mayadhar Behera	55	- do -	Paddy	Black gram	35 years
10.Banshidhar Nayak	55	- do -	Paddy	——	30 years
11.Rajkishor Khuntia	60	- do -	Paddy	Blackgram,	40 years
12.Joginath Parida	55	- do -	Paddy	——	40 years
13.Alekha Parida	40	- do -	Paddy	——	35 years
14.Sudarshana Mahabhoi	32	- do -	Paddy	——	25 years
15.Prafulla Mahabhoi	60	- do -	Paddy	——	40 years
16.Meghanada Khatua	45	- do -	Paddy	Vegetable	30 years
17.Nakula Mahabhoi	55	- do -	Paddy	——	30 years
18.Bharat Samal	55	- do -	Paddy	——	34 years
19.Akhila Mahabhoi	42	- do -	Paddy	——	30 years
20.Ranjan Patra	35	- do -	Paddy	——	25 years
21.Bidhyadhar Nayak	55	- do -	Paddy	——	27 years
23.Ramesh Sahoo	32	- do -	Paddy	——	22 years
24.Kailash Behera	50	- do -	Paddy	——	35 years
25.Govinda Sahoo	35	- do -	Paddy	——	25 years
26.Kailash Sahoo	40	- do -	Paddy,Groundnut	Sugarcane	28 years
27.Gokula Mahabhoi	50	- do -	Paddy	——	30 years
28.Tankadhar Khatua	60	- do -	Paddy	Sugarcane, Blackgram, Vegetable	45 years
29.Hadibandhu Nayak	70	- do -	Paddy	——	42 years

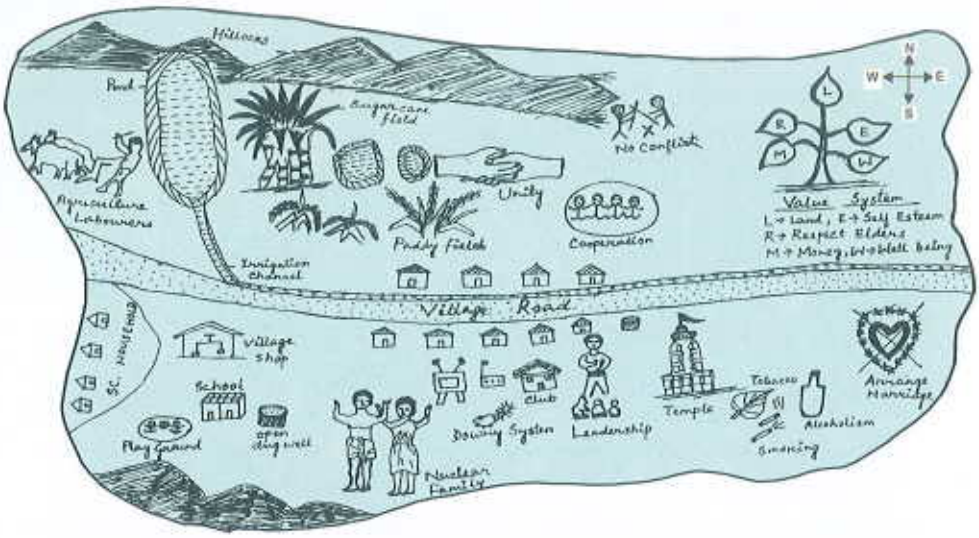
Table 2 : Transect of the village

Land	Highland (33%)	Medium land (30%)	Low land (37 %)
Productivity	Low	Low	Medium
Soil type	Sandy loam	Silty loam	Clay loam
Land use	Dwelling houses, animal sheds, primary school, club, kitchen garden, upland rice, rainfed ponds, orchard.	Crop field, grazing land, fish ponds	Crop field, grazing land
Crops	Rice, cashew, vegetables, Horse gram.	Rice, vegetables, sugar cane, blackgram	Rice, green gram, blackgram, lathyrus Sugarcane
Trees	Bamboo, mango, drumstick, jack fruit, palm, date palms, fig, guava, banana.	Palm, teak, sal on bunds	-----
Livestock	Cattle, goats, sheep, ducks, poultry.	Ducks in tanks	-----
Fishery	Fish culture in tanks and ponds.	Fish culture in tanks and ponds	-----
Water resource	Rainfed ponds, tube wells, dug wells.	Rainfed pond	-----
Water table	2 - 5 m	1.5 - 2.0 m	0.5 - 1.5 m

Table 3: Social resources of the village

Sl. No.	Social institute	Present/absent in the village	If not, near by location
(1)	Primary school	Present	
(2)	High school	Absent	Alnabereni (2 km)
(3)	College	Absent	Pandua (12 km)
(4)	Post office	Absent	Alnabereni (2 km)
(5)	Primary health centre	Absent	Kamakhya Nagar (7 km)
(6)	Gram Panchayat	Absent	Katni (2 km)
(7)	Temple	Present	
(8)	Youth club	Present	
(9)	Mahila Samiti	Present	
(10)	Gramya Bank	Absent	Alnabereni (2 km)

Diagramme -1 : Social map of Arnapurnapur village

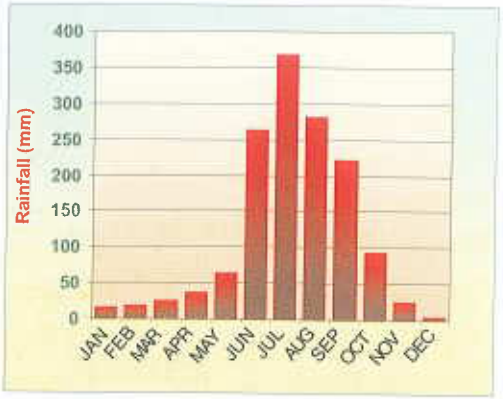


smoking, playing cards are prevalent in the village. The community media are mainly radio, television and newspapers.

(3) Resource map :

The resources of the village are characterised through resource map depicted in diagramme 2. It reveals that the village is mainly agrarian, surrounded by hillocks and forests. Teak and Sal are the major forest trees and cashew orchards are found in the village. The cashew orchards are one of the major sources of income of the villagers. Rice is the main crop in the *kharif* season. Groundnut is also sown by some farmers during *kharif* as monocrop. A small area is under sugarcane cultivation where irrigation facilities exist. Bullock cart are used for transport and country plough for ploughing. Apart from sickle and spade, equipment like sprayer, motor pumps are also being used in the village. Main source of water for agriculture is rainfall in *kharif* and harvested water in the pond during *rabi* season. Two open wells and a hand pump are also available for drinking purpose. There is no fertilizer and other agricultural input shop in the village. All the livestock like cattle, goats and poultry are *deshi* type.

Typical soil profile of upland experimental site



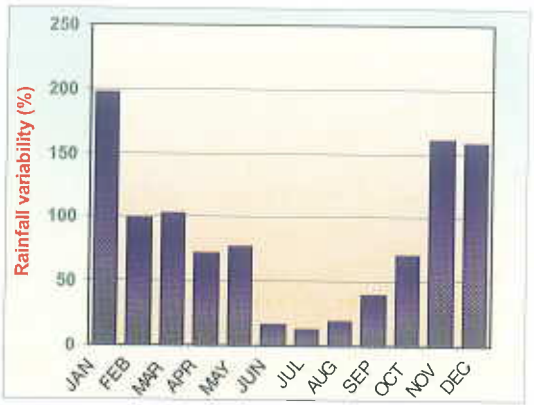


Fig. (5) Mean monthly rainfall and rainfall variability of Dhenkanal district

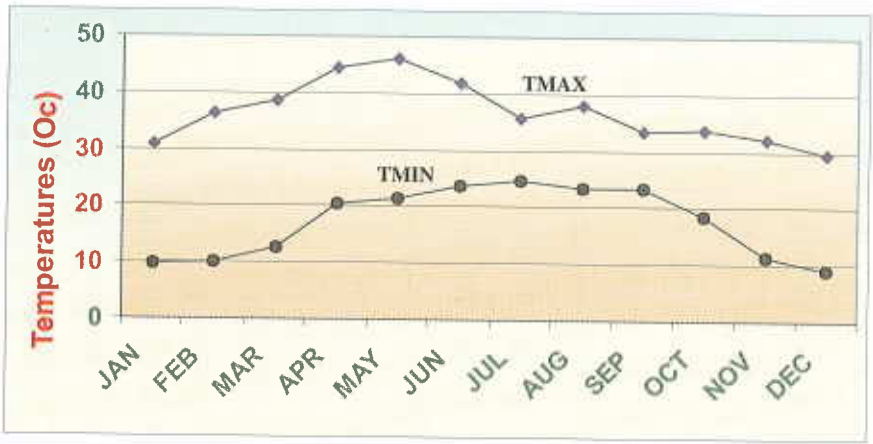


Fig.(6) Variation of maximum and minimum temperatures in Dhenkanal district

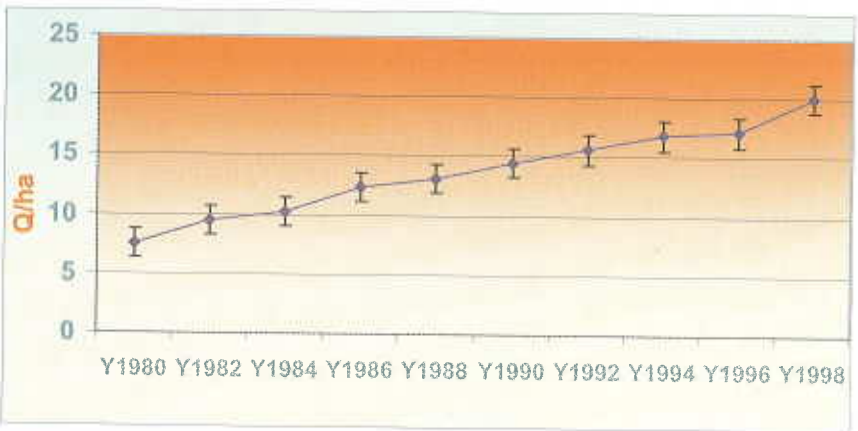
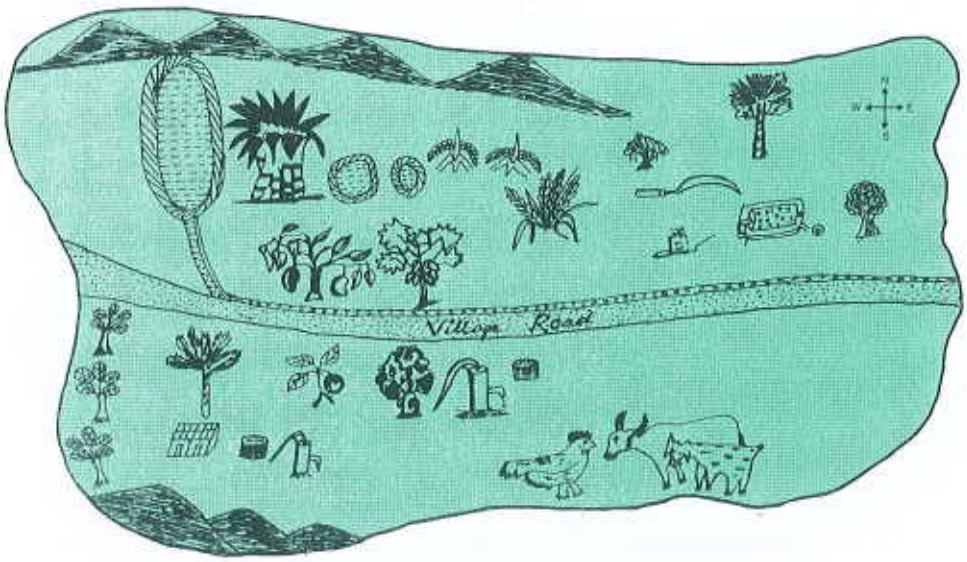


Fig.(7) Time line for average paddy yield at Arnapurnapur village

(4) Agro-ecology map:

Agro-ecological map indicates the climatic and environmental conditions in relation to agriculture, animal husbandry and fishery for the village. It helps in better understanding of the village topography, land use/land cover, soil type, variation of main climatic parameters, hydro-geomorphological features, irrigation system prevailing in the village, cattle tracts, dominant crops, trees, shrubs, weeds and any other aspects related to agro-ecosystem. The agro-ecological conditions of Arnapurnapur village were studied and depicted in diagramme 3. Study reveals that climate of the area is hot-subhumid and according to the NARP (1979) classification it belongs to mid central table land zone of Orissa. The mean annual rainfall of the area is around 1400 mm and 80 % of the rainfall is due to south west monsoon with highest rainfall during July. Average number of rainy days are 73 in a year. The south west monsoon normally onsets on 10th June. Rainfall statistics shows that coefficient of variability of rainfall (Fig. 5) is very high (99-197%) during winter and low in the month of July (13.1%), followed by June (17.2%) and August (19.9%). The mean annual maximum and minimum temperature are 36.8 ^{0}C and 17.3 ^{0}C, respectively (Fig. 6). The soils of the area is light textured lateritic. Taxonomically the soils belonged to category of the fine, loamy, mixed iso-hyperthermic Typic Haplustalf. The texture of this horizon is sandy clay loam to clay loam and structure is moderate, medium sub angular blocky. The soil reaction is moderately acidic. The fertility status of the soils is also very poor. The soil physical and phyco-chemical properties of the upland soil are given in table 4.

Diagramme -2 : Resource map of Arnapurnapur village



The village is surrounded by small hillocks and the hillocks serve as catchment area of village ponds. Regarding land use/land cover, rice is dominant crop during kharif. During *rabi* some farmers grow blackgram, horsegram and vegetables like brinjal, chillies, tomato, cucumber, gourds etc. Upland crops are generally infested with weeds *like Cyprus Sp. Cynodon Sp., Echinochloa Sp., Euphorbia Sp., Lantana Sp.* etc. In addition to cashew orchard, some fruit trees like mango, jack fruit, coconut, ber, papaya, guava, tamarind, coconut, jamun etc. are available adjacent to the farm houses. Besides these, some tree species like neem, bamboo, sal are also found in the village.

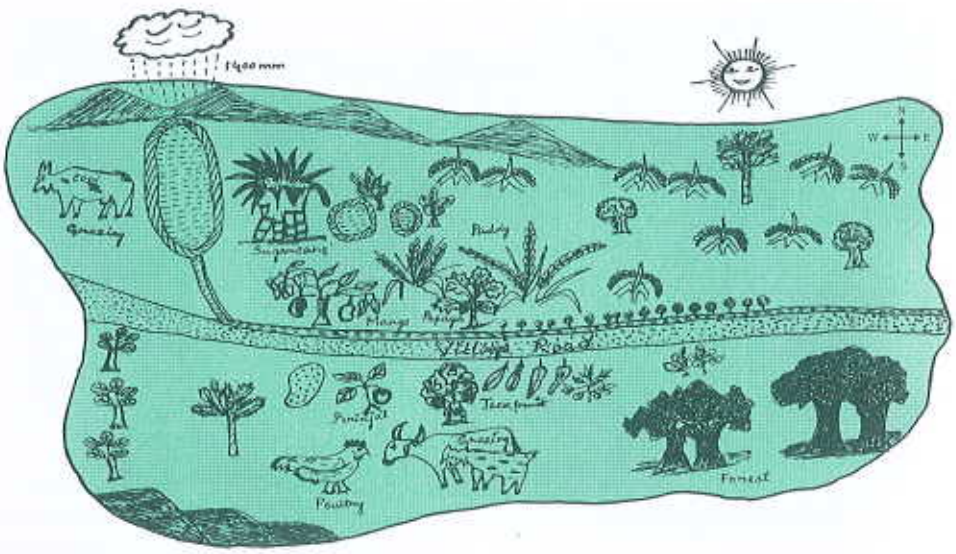
There is no deep tube well in the village for irrigation purpose. The ground water table of the village fluctuates between 50 cm during *kharif* to more than 5 meter in summer. All livestock are indigenous type. The village is having large grazing and waste land in the upland situation.

(5) Matrix ranking and technology adoption :

Matrix ranking is an analytical test to find out reasons for adoption, discontinuance, rejection, over adoption and reinvention of various technologies related to agriculture. The purpose of this study was to get better understanding of farmer's decision making processes and to identify criteria used to prioritize and select certain items or activities over others. The technology adoption profile was studied and depicted in diagram 4.

The study reveals that before intervention through NATP project, farmers were having very poor knowledge in improved farming technologies. They have been growing

Diagramme -3 : Agro-ecologocal map of Arnapurnapur village



high yielding varieties of rice *viz.*, CR-1030, Swarna, Lalat, CR-1014, CR1014 Parijat etc. in low and medium land because of their higher yield. Mould board plough and sprayer are two implements adopted by the farmers because of their easy operation. Chemical fertilizer and insecticides are adopted by some farmers for their capacity to increase crop yield. Tractor and Power tiller are not used because of their high cost. Improved agronomic practices and cropping system were not practised due to the lack of knowledge. In the village there was no improved livestock . The reason is high cost which is not affordable by poor farmers. As a result, improved livestock facilities, like use of concentrated feed or artificial insemination etc. do not exist in the village.

After introducing the crop diversification trials in upland by Water Technology Centre for Eastern Region (I.C.A.R.), Bhubaneswar farmers were asked to rank the technology based on net economic return. The matrix ranking for adoption of crop varieties and inputs, done by different key informants are presented in table 5 (a) and 5(b). It is found from the table that farmers want to adopt 'Vandana' variety of rice in upland because of its short duration, drought tolerance and non-lodging characteristics. They prefer 'Smiriti' variety of groundnut because of its higher productivity, red karnel and good market. The 'UPAS-120' variety of pigeonpea is preferred for its higher productivity and short duration. They prefer 'Vijay' variety of maize because of its short duration, less water requirement and high income.

(6) Time line:

It is a chronological sequence of events that have taken place in a village or area.

Diagramme-4 : Technology map of Arnapurnapur village

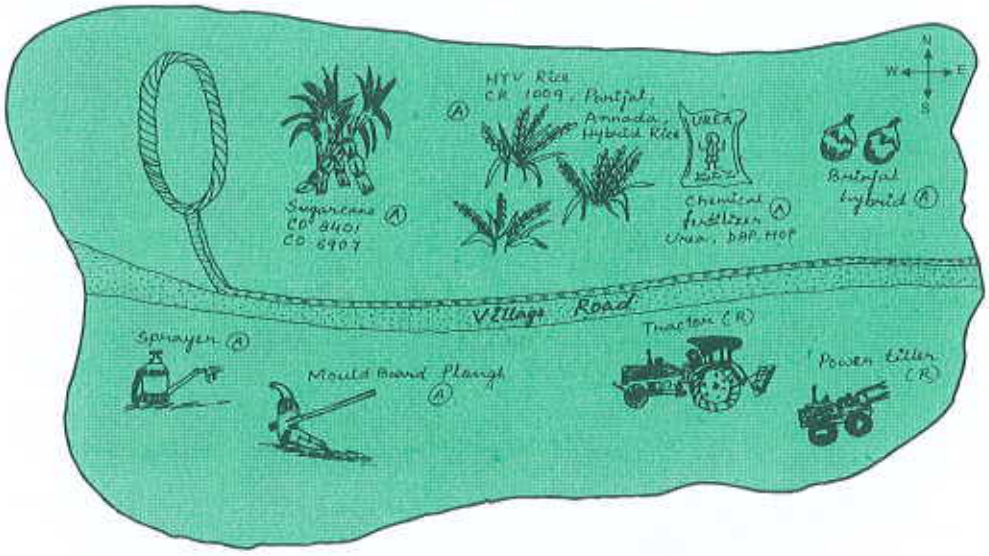


Table 4 : Average soil physico-chemical properties of upland site

Soil depth	Clay (%)	Silt (%)	Fine sand (%)	Coarse Sand (%)	EC2 (dS/m)	PH2	Org. Carbon (%)	Ks (cm/hr)	CEC (me/ 100 gm)
10-15	21.8	13.7	20.1	44.4	0.05	6.0	0.584	0.624	12.7
15-30	31.6	16.2	17.2	35.0	0.06	6.5	0.452	0.601	16.5
30-60	37.7	16.8	14.2	31.3	0.0	6.6	0.462	0.542	17.6
60-90	38.9	15.1	13.0	33.0	0.08	6.8	0.293	0.521	19.7
90-120	39.1	16.7	11.4	32.8	0.04	7.0	0.271	0.503	20.1
120-150	39.3	16.9	11.4	32.4	0.04	7.0	0.235	0.483	20.3

Table 5 (a) : Matrix ranking of crop varieties in upland

Criteria	Vandana	Vijaya	Smriti	UPAS-120	Pusa Kamal	T9	Total Score	Rank
High yield	III (8)	II (9)	I (8)	III (6)	IV (6)	IV (4)	41	I
Shot duration	I (8)	I (8)	II (6)	III (6)	II (9)	II (6)	41	I
Quality	III (7)	II (8)	I (9)	IV (6)	V (3)	IV (6)	39	II
Disease-pest resistance	III (5)	II (6)	I (8)	III (5)	IV (4)	IV (4)	32	V
Fodder/Fuel	I (8)	II (7)	III (5)	III (5)	IV (4)	IV (4)	33	IV
Market price	V (4)	I (9)	II (8)	III (7)	Iv (5)	IV (5)	38	III
Ease of adoption	I (8)	II (7)	II (7)	III (6)	IV (5)	III (6)	39	II
Total score	46	52	51	41	33	34		
Rank	III	I	II	IV	VI	V		

Table 5 (b) : Matrix ranking of inputs (fertilizer & implements) to increase crop Productivity

Criteria	Deshi plough	M.B. plough	Tractor	Urea	DAP	Pesticides	Sprayer	Score	Rank
Ease of adoption	I (7)	II (6)	VI (1)	III (5)	III (5)	IV (4)	V (3)	31	III
Less laboure cost	II (5)	II (5)	I (6)	III (5)	III (5)	IV (4)	V (3)	33	II
Credit facilities	I (7)	II (6)	VI (2)	II (6)	II (6)	III (4)	IV (3)	34	I
Capacity to increase yield	IV (3)	II (3)	III (4)	I (7)	I (7)	II (5)	II (5)	34	I
Market price	I (7)	II (5)	VI (1)	III (4)	III (4)	IV (3)	V (2)	26	IV
Total score	29	25	14	27	27	20	16		
Rank	I	IV	VII	II	III	VI	VI		

Those may pertain to the general history of the village, or to specific subjects or sectors such as health, education, agriculture, animal husbandry etc. The time line for different activities before starting of the NATP project were studied and are given in table 6.

(7) Time trend :

Time trend reflects the quantitative changes of particular activities or products over a period of time. It represents the rate of progress and development in the rural area. Time trend of paddy yield of past 20 years were studied and are presented in Fig. 7. Study reveals that average paddy yield has been increased from 7.5 q/ha to 20 q/ha in the past 20 years.

(8) Indigenous Technical Knowledge (ITKs) :

Indigenous technical knowledge is based on experience, often tested over long period of use, adopted to local culture and environment, dynamic and changing and lay emphasis on minimizing risks rather than maximizing profits. It is the knowledge that people in a given community have developed over time, and continue to develop it. It covers various aspects of agriculture and allied activities such as soil, water and nutrient management, crop cultivation, plant protection, farm equipment, post harvest preservation, animal rearing and health care, animal products preservation and management, fisheries and fish preservations, weather forecasting etc. Some of the ITK's on various aspects of agriculture are studied and are given below.

(A) Rainwater management :

(i) Use of cowdung, leaf litter in field to improve soil fertility and rainwater holding capacity of the soil.

(ii) Summer tillage after pre-monsoon shower for early rainwater conservation in situ.

(iii) Storing of rainwater in pond for providing supplementary irrigation during *rabi.*

(iv) Making of dykes/bunds around the field to retain water for paddy cultivation.

(B) Tillage and intercultural management :

(i) For utilizing residual soil moisture in low land, farmers prefer relay cropping with lathyrus, gram, pea during *rabi.* But they found more germination and growth of the crops when minimum tillage is applied for better soil-seed contact, less weed infestation etc.

(ii) Use of country plough for land preparation and line sowing in upland. Farmers place the seeds in furrow at the depth of 3 cm.

(iii) Farmers prefer leveling of land and pulverizing the soils with ladder.

(C) Pest and disease management:

Agriculture:

(i) Change of crops/varieties or crop rotation in a particular field for minimizing pest and disease infestation.

(ii) Use of cow dung ash for controlling pests in vegetable crops, spraying of kerosene to control pigeonpea blight disease.

(iii) Early sowing of blackgram, green gram to avoid mosaic diseases.

(iv) Healthy seeds for better germination, good plant vigour and less diseases.

(v) Summer tillage after pre-monsoon shower to control soil borne pathogens, weeds

(vi) Use of scarecrow for frightening birds in crop fields.

Livestock:

(i) Feeding of bamboo and mung leaves to control loose motion of cows. Feeding of salt, jaggery and 'thantitri' leaves for indigestion.

(ii) Application of hot water, merigold leaves, karpur, coconut oil to control leg diseases of cow.

(iii) Use of lemon leaf juice for skin diseases.

(iv) 'Ganga seuli' leaves, '*Satabati*' leaves, '*Nir Amuli*' leaves to check cow fever and '*Bisalyakarani*' leaf to control bleeding.

(v) Use of 'Kansa' leaf for controlling eye problem of cows.

(vi) Running of bullock into mud to control foot and mouth disease.

(D) Weather forecasting:

(i) Climbing of wild rat on tree forecasting rain.

(ii) Ants coming out of the hole or migrating with eggs in the mouth indicating heavy rain.

(iii) Blowing of wind in cloudy climate indicates no rain .

(iv) Movement of white cloud on the sky is an indication of no rain. Dark clouds, lightening in the north east coupled with moon engulfed by hallow are the indication of rain.

(v) Very scorching sun in the forenoon and afternoon during post-monsoon and monsoon season indicate rain in the evening.

(vi) Deforestation or cleaning jungle is the main cause of drought.

(vii) If crow cries during the night and fox howls during the day there would be a severe drought.

(E) Crops and cropping system :

(i) Use of bullock cart for transport of agricultural inputs and outputs.

(ii) Use of dhaincha as green manure and FYM as nutrient source after pre-monsoon shower to enhance crop yield.

(iii) Growing of short duration paddy in upland to complete life cycle of the crop before withdrawal of monsoon.

(iv) Crops sown in line gives better yield.

(v) Country plough is used for line sowing to save labour.

(vi) Broadcasting of pulses as relay crop in standing paddy crop is preferred to utilize residual moisture in low land.

(vii) Puddling is done with country plough and ladder for weed control.

(viii) Removing upper twigs at early stage of vegetable crops facilitates branching.

(F) Post harvest technology and preservation :

(i) Mixing of mustard oil with black gram to avoid pest attack.

(ii) Use of *kothi* (made of wood, sori, bamboo) for grain storage.

(iii) *Dhenki* is used for dehusking paddy .

(iv) Use of lemon leaf for storing black gram .

(v) Use of salt and turmeric for fish storage.

(G) Cattle feed and fodder management

(i) Indigenous chopping implements for stall feeding - Cattle raised by subsistence farmers live mainly on stored rice straw and grasses. Framers use home made chopping implement to cut rice straw and grasses to stall feed the cattle.

(ii) Grazing on rice stubble in the field - Cattle are allowed to graze in the field after harvesting of paddy. The cowdung falling in the field during grazing enriches the fertility status of the field.

(9) Wealth ranking:

Wealth ranking is carried out to study the perception of wealth differences and inequalities in community and to establish relative position of households in the community. Wealth ranking has been carried out with the help of local key informants based on some criteria like income, assets, employment etc. Study found that only one category of wealth classes exit in the village i.e. poor category and source of income is

only agriculture. Each farmer is having the average cultivated area of about 2.5 hactare and one or two desi cattle.

(10) Livelihood analysis :

Livelihood analysis is the study of income and expenditure of the dwellers of the village. Since 'poor category' with land and landless are found in the village, so various sources of income and major items of expenditure are of poor categories. The component of income and expenditure is depicted in diagramme 5. Poor with land holding people earn mainly through agriculture (75 %), labour wages during lean period and animal husbandry (20 %), and 5% through service and business. They spend most of their earning on food, household, purchasing agricultural inputs, cloths, house repairing. They also keep some share of amount for festivals, education and medicine. The 'landless poor' earn their livelihood mostly from labour wages (80 %), fuelwood collection, and animal husbandry (15 %). They spend money mainly on food and households, repairing houses, festivals, social obligations etc.

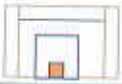
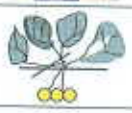
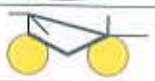
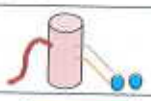
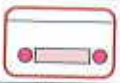
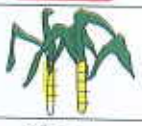
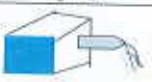
(11) Venn diagram : ('Chapati' diagram):

A 'Venn diagram' for Arnapurnapur village is represented in diagramme 6, which shows relationship of various institutions, organizations, policy makers or individuals with each other and with the village as perceived by the villagers. The purpose of venn diagram is to get the villagers perspective on the impact/influence of local and outside institutions in a particular area. Major organizations engaged for various activities in the village are W.T.C.E.R., Bhubaneswar, State Agricultural Department, State Horticultural Department, Soil Conservation Department, KVK, Dhenkanal. The agricultural department provides seeds of new crops/varieties and farm implements at subsidised rate. State soil conservation department has constructed a check dam in forest catchment. Presently, Water Technology Centre for Eastern Region (W.T.C.E.R), Bhubaneswar is working closely in the village for increasing cropping intensity and crop diversification. This organization has already introduced some new technologies, cropping system in upland (maize followed by horsegram/sesamum, groundnut +pigeonpea followed by sesamum) which are being adopted by the farmers. The KVK has also introduced some high yielding rice varieties in the village. State Horticulture Department has helped in maintaining a cashew orchard in the village. The other minor organizations like DRDA, health centre, ZRS, OUAT, NGO's have very less interactions and contact with the villagers.

(12) Mobility diagram :

The mobility map depicts the movement of villagers for various activities and purposes like purchase of seeds, pesticides, laborers, hospitals, marketing etc. The

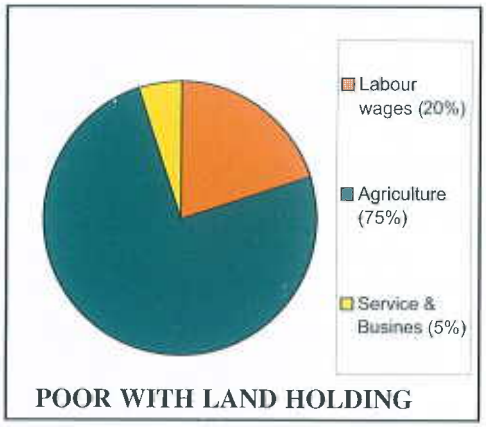
Table 6 : Time line for different activities of the village

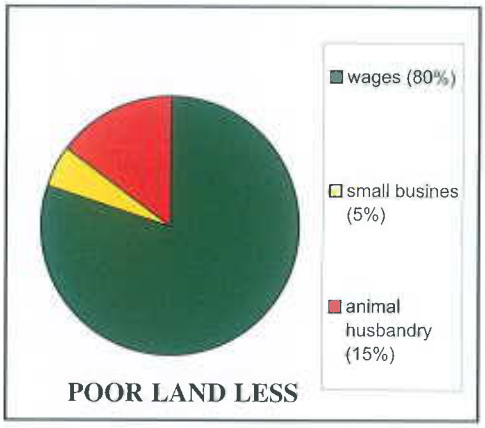
EVENTS	YEAR	
Use of check dam for irrigation	1955	
Primary school established	1965	
DAO, Dhenkanal first visit for potato project	1974	
Introduction of high yielding rice varieties, Chemical fertilizer, sprayer	1974	
Bicycle introduced	1975	
Cashew orchard established	1980	
Mahila Samiti, Club established	1980	
Use of mould board plough	1982	
Panchayet established	1985	
Electricity connection provided, Bus service started.	1990	
Tube well constructed	1994	
Television adopted	1995	
Sugarcane cultivation and assistance of M/S Shakti Sugar, Dhenkanal	1996	
Pump set used	1997	
Starting of NATP project by WTCER, Bhubaneswar	1999	

purposes like purchase of seeds, pesticides, laborers, hospitals, marketing etc. The duration, mode of transportation, frequency and direction of movement are also indicated in the mobility map. The mobility of the villagers was prepared and is presented in diagramme 7 and table 8. In the village, no modern facilities exist, as a result villagers depend on nearby villages, block, district headquarter for various facilities. They go nearby village Alnabereni (5 km) for small marketing and purchase and sale of livestock . For bank, panchayat work, widow pension, they visit Katani gram panchayat (1 km). For land registration, inputs purchasing, post office, farmers frequently visit their block headquarter, Kamakhyanagar (10 kms). They go district headquarter, Dhenkanal (30 km) for

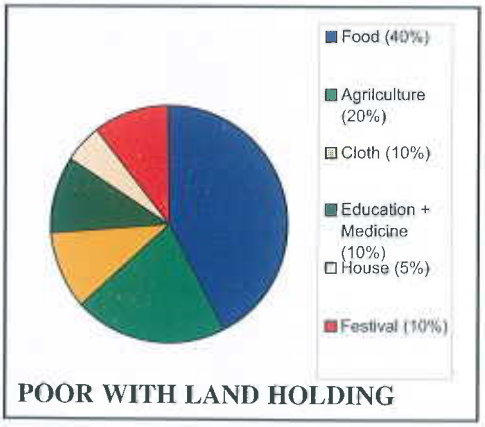
Digramme-5: Livlihood analysis of the village Arnapurnapur

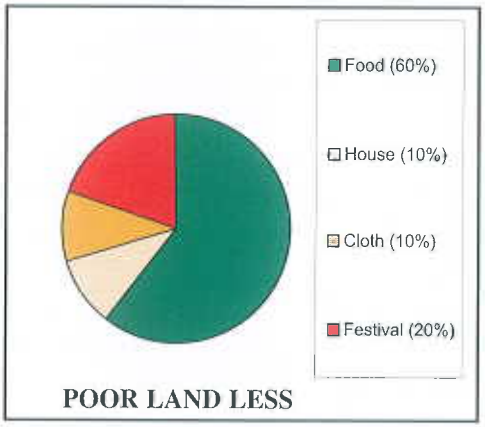
Sources of Income





Expenditure





for legal works, collector's office, hospital, M/s. Shakti Sugar factory etc. From nearby 'Kantapal' village (2 km), they hire tractor and for paddy, wheat, oil crushing they go Mahuli village (2 km). They also visit CRRI, Cuttack once in a year to purchase improved variety of paddy and to get training. In the village bullock cart is the main mode of transport. They avail bus, zeep, taxi facilities from 'Aluajharana' bus stop (1 km). They also visit village 'Tumisinha' (5 km) for police station and gramya bank.

(13) Seasonal analysis:

Seasonal analysis is carried out to get insight into the seasonal variation of different activities in rural areas with respect to farming operations, rainfall occurrence, disease outbreak, labour migration, festive season, employment etc. Seasonal analysis for the study village is shown in diagramme 8 which are prepared on the basis of interview, group discussion using stones and sticks of various length. The study indicates that main cropping season starts from June after a local festival 'Raja'. Generally during second week of June, they celebrate 'Raja' festival when they assemble at a common place with new dresses and perform dance drama. During June and July farmers are busy in collecting inputs like seeds, fertilizers. Rain is mainly confined to south west monsoon season i.e. from second week of June to last week of September. In July and August farmers are busy in rice land preparation and rice transplanting. During that time farmers face the problem of labour shortage. During September– November, rice pest outbreaks. They sow *rabi* crops like horse gram, sesamum under rainfed condition during October and harvest the *kharif* paddy during November – December. During April - May, no agricultural operation is performed and as a result labour migration is noticed. They also repair and colour their houses during March to May. During March, April and May, they require financial assistance from money lenders, banks and friends etc. Seasonal human diseases are common after withdrawal of monsoon (October). Foot and mouth disease of cow occurs during August- September after transplanting of *kharif* rice. The festivals like 'Sivaratri', 'Holi', are celebrated in March, 'car' festival in July, 'Dusshera' in October, 'Diwali' in November.

(14) Preferential ranking :

Villagers preference and attitude towards a particular crop of interest have been revealed by this technique. It helps in understanding farmers priorities of field crops, vegetables, fruit trees, animals etc. The villagers were asked to indicate their choice by putting stones to each crop for upland according to their preferences and the details of preferential ranking is given in table 7(a) & 7(b). Among sole crops maize is the best preferred followed by groundnut, pigeonpea and Vandana rice. Groundnut + pigeonpea inter-cropping is preferred most because of its market value, productivity and yield certainty(These preferences are based on the results of NATP trials and demonstrations).

(15) Consequence diagram:

Consequence diagram is a type of flow chart which depicts the impact of any interventions in the village. The effects may be positive or negative. This diagram shows the impact point and linkages established as a result of impact. The consequence diagarm for crop diversification in upland and discontinuance of rearing of cross breed cow is shown in diagram 9(a) and (b), respectively. The villagers feel that crop diversification with low water requiring, short duration oilseeds, pulses, cereals and millet's in upland will give more food security and return than that of paddy and as a result their standard of living will be improved. The negative impact may come in the form of environmental pollution because of more fertilizers and pesticides use.

The diagram 9 (b) indicates that due to discontinuance of rearing of cross breed cow, expenditures on fodder, veterinary care, labourers have been reduced but milk yield and income have also become less. As a result the total income from rearing of cow has been reduced.

(16) Farm Household:

A representative household in the village was identified through transect walk. This house belongs to Mr. Meghnath Khatua. The house is made up of lateritic stone, plastered with mud with thatched roofing. There is a cattle shed in front of the house. In the back yard of the house, there is an open space to perform various agricultural activities after harvesting. The farmer maintains a very small kitchen garden wherein vegetables like chillies, brinjal, cowpea, sprinach, tomato, bitter ground are grown. Besides these, there are some perennial trees like mango, jack fruit, papaya, banana etc. adjacent to the house. The farmer also have 2 milch cows. In the open space adjacent to the house, farmer stacks paddy straw which is used to feed the cattle and make thatches. One compost pit is also situated in the backyard of the house.

(17) Daily routing diagram:

Daily routine diagram depicts the different activities of rural people on daily basis. In the village daily routine differs according to the season. The farmers are busy mainly during monsoon season performing agricultural operations in the fields. During day time of the *kharif* season farmers are engaged in sowing, transplanting of rice, interculture, weeding etc. In the evening either they assemble at a place to discuss important activities of the village or they remain busy in marketing. The women farmers assist different farm activities mainly manuring, paddy transplanting, seed sowing, gap filling, thinning of plant population, weeding etc. The different post-harvest activities like making of heaps of harvested paddy, threshing, winnowing, drying and cleaning of grains, rice processing,

Diagramme-6 : Venn diagram of the village

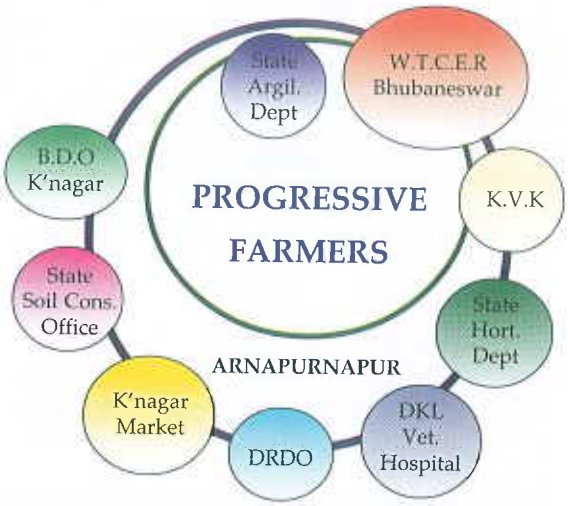
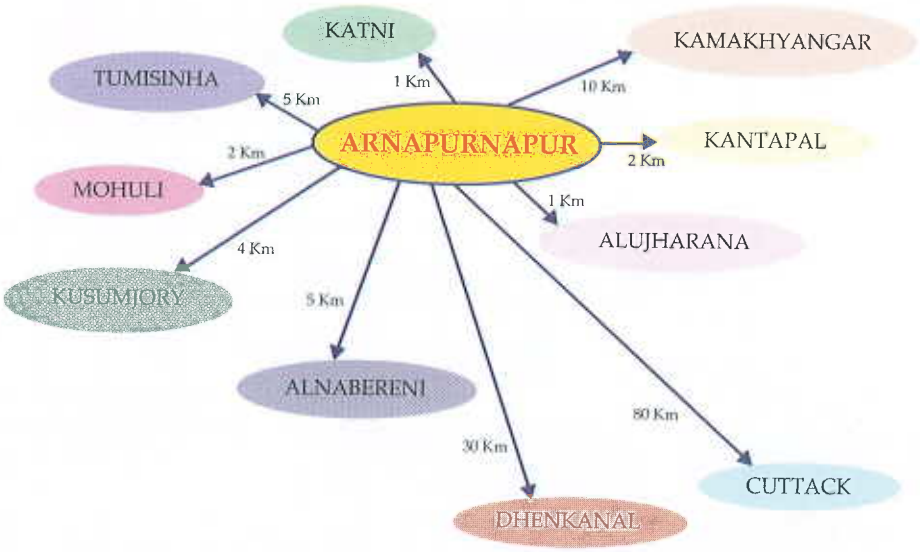


Diagram-7 : Mobility diagram of Arnapurnapur village



treating grains with insect repellent etc. are mainly performed by women farmers. Women also spend their time in different household activities like feeding children, grazing livestock, collecting fuel wood, cooking, house maintenance etc., In winter season some farmers of the village perform agricultural operations like sowing pulses, relay cropping and sugarcane planting. During summer, farmers have no work in the field and keep

Diagramme - 8: Seasonal analysis

ITEMS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Festivals			Holi, Shiva Ratri			Raja	Car festival			Dusserah	Diwali	
Sowing & Transplanting of paddy												
Weeding												
Labour shortage												
Rainfall												
Food security												
Animal diseases												
Paddy pest attack												
Loaning Period												
House repairing												
Surgarcane sowing												
Harvesting of paddy												
Labour migration												
Sowing of rabi pulses, relay cropping												

DIAGRAM 9(A) : CONSEQUENCE DIAGRAM (AGRICULTURE)

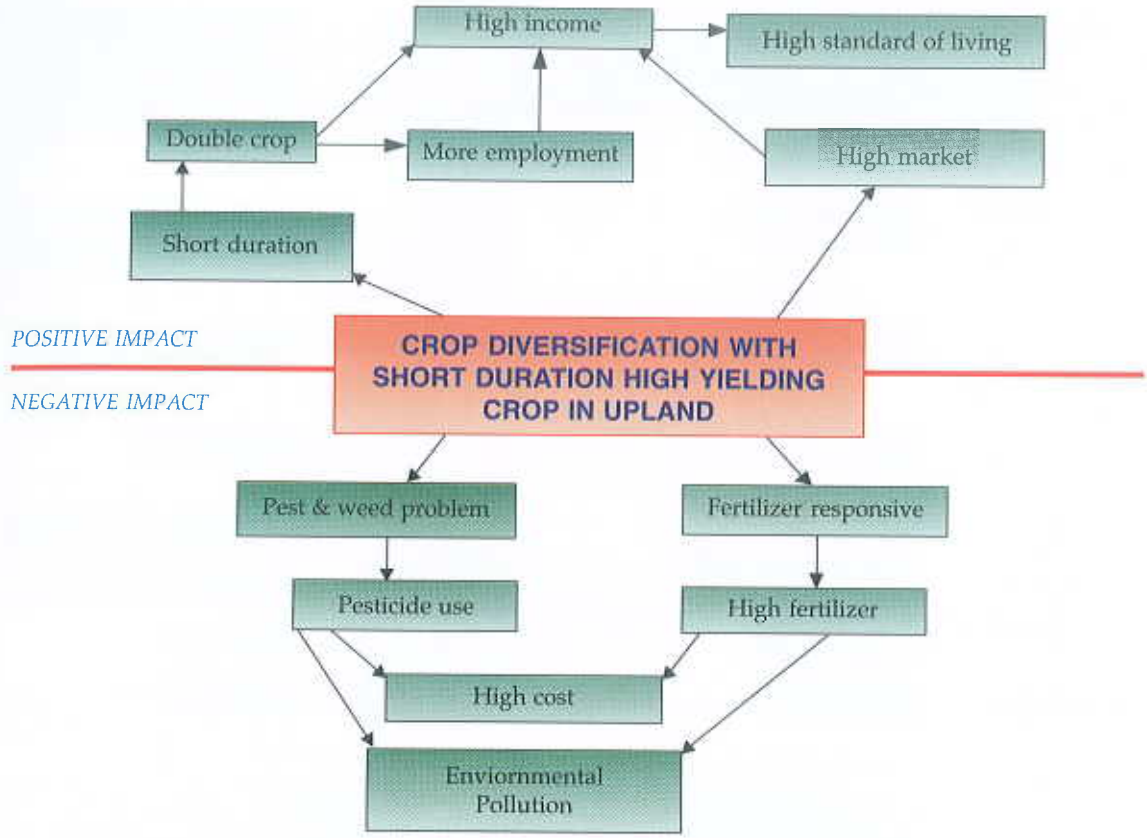


DIAGRAM 9 (B) : CONSEQUENCE DIAGRAM (ANIMAL)

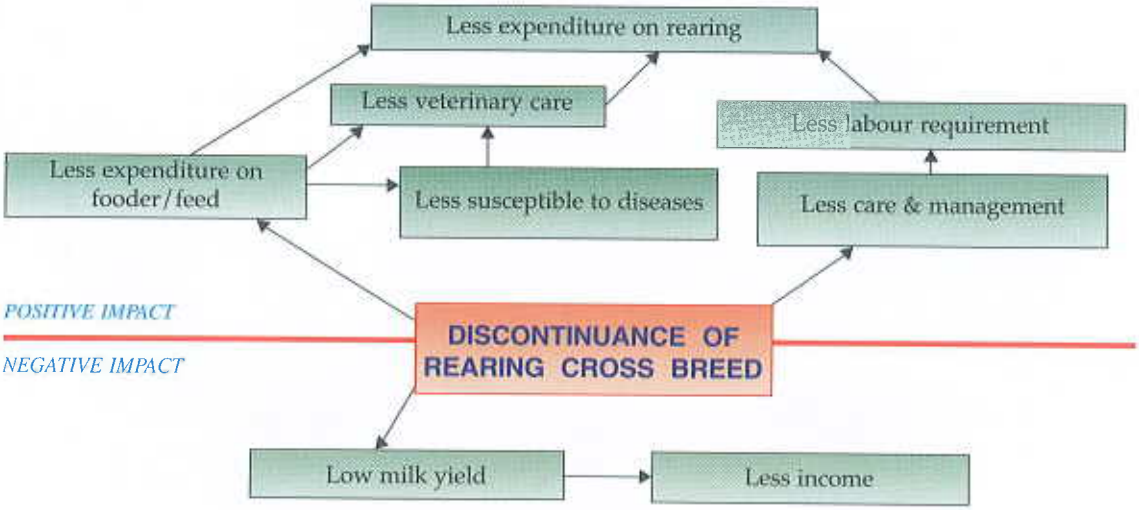


Diagram-10 : Typical daily routine of farmers during Kharif season

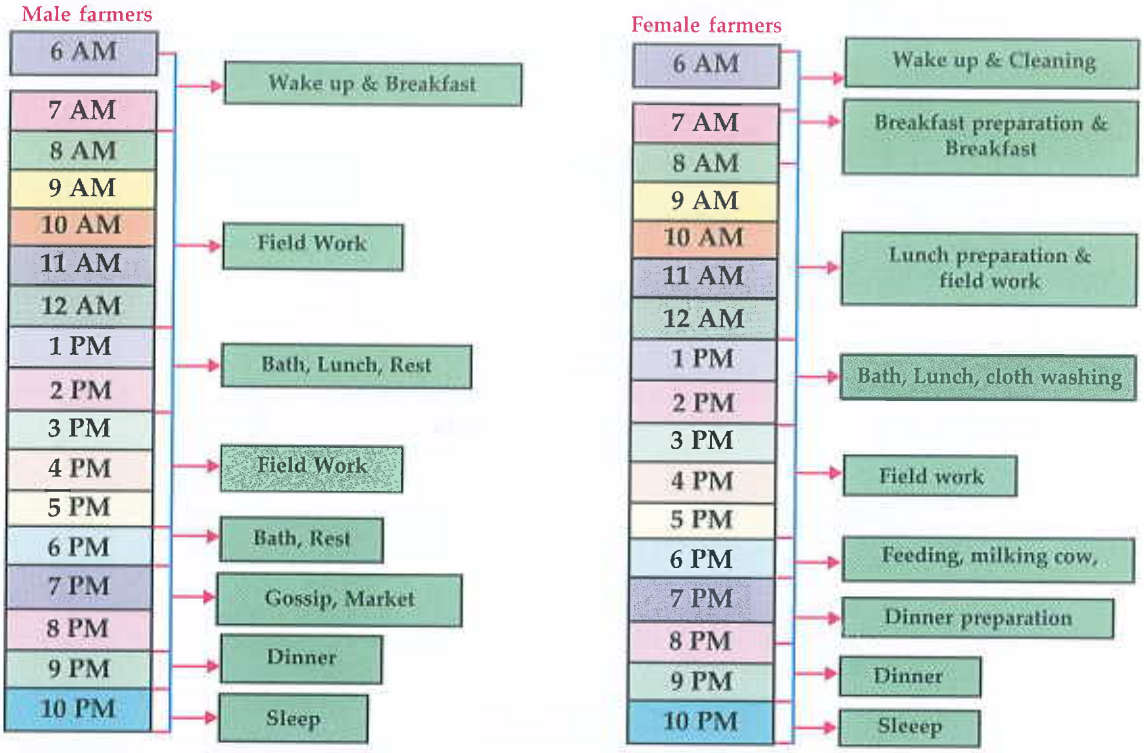


Diagram - 11 : Resource flow diagram of a typical household of the village

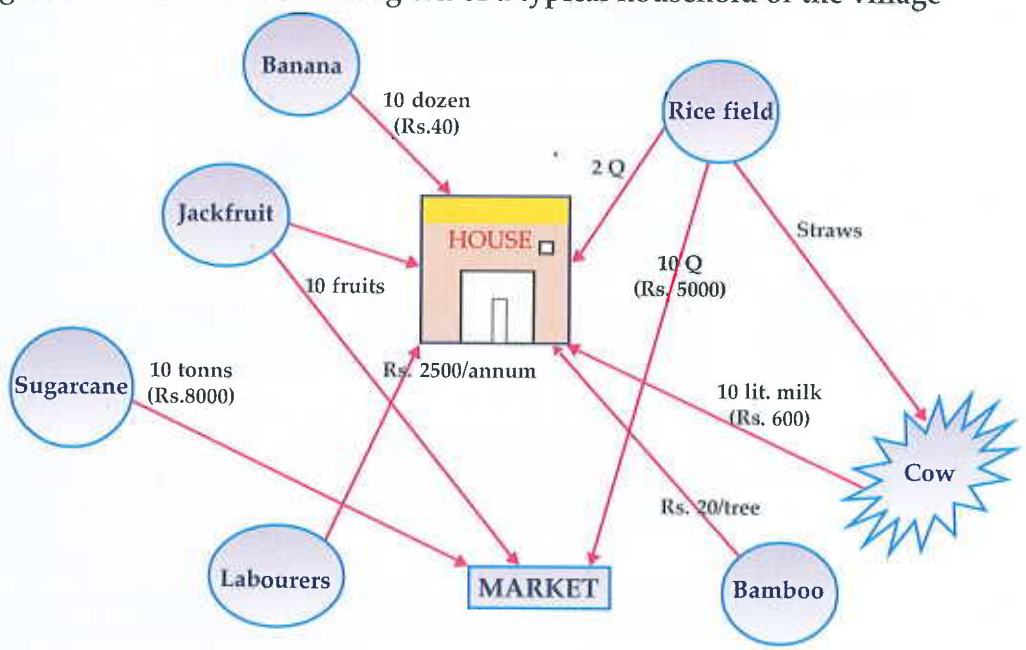


Table 7 (a) : Preferential ranking of crops in upland to increase productivity and cropping intensity

Crops	Food	Fodder/ Fuel	Market Value	Duration	Yield Certainty	Productivity	Lodging	Total Score
Rice (Vandana)	10	9	4	5	4	5	8	45
Rice (Kalinga - III)	10	9	4	5	4	5	4	41
Blackgram	5	5	6	7	7	5	8	43
Cowpea	5	5	5	8	8	5	8	44
Pigeonpea	6	6	8	4	5	8	8	45
Maize	8	6	8	9	8	8	8	55
Greengram	5	5	5	7	7	5	8	42
Groundnut	6	6	6	7	8	8	8	52

KI : Iswar Samal, Sibaram Sahoo and Megnath Khatua, Maximum score : 10

Table 7 (b) : Preferential ranking of inter-crops in upland to increase productivity and cropping intensity

Crops	Food	Fodder / Fuel	Market Value	Duration	Yield Certainty	Productivity	Lodging	Total Score
Groundnut + Pigeonpea	8	8	7	6	8	8	8	53
Rice + Pigeonpea	9	9	4	5	4	5	8	44
Maize + Cowpea	7	7	8	5	9	8	8	52
Groundnut + Greengram	5	5	6	7	7	5	8	43
Groundnut + Blackgram	6	6	9	7	8	8	8	52

KI : Iswar Samal, Kasinath Samal, Sibaram Sahoo, Tankadhar Khatua and Megnath Khatua Maximum score : 10

Ta1ble 8: Mobility table of Arnapurnapur village

Sl. No.	Place	Distance	Mode of transport	Purpose	Frequency
1.	Katni	1 km	Walking, bicycle	Gram Panchayat	Twice in a month
2.	Tumisinha	2 km	Walking, bicycle	Police station, widow pension	Once in a month
3.	Alujharna	1 km	Walking, bicycle	Bus stop, sweet marketing	Daily
4.	Mohuli	4 km	Walking, bicycle	Oil crushing	
5.	Alnabereni	5 km	Walking, bicycle	Weekly market(hat), gramya bank, fertilizer pruchase	Once in a week
6.	Kusumjori	4 km	Walking, bicycle	Grocery shop	Twice in week
7.	Kamakhya nagar	10 km	Bus, tracker, zeep	Block office, animal sale and purchase, inputs purchase	Once in week
8.	Dhenkanal	30 km	Bus, tracker, zeep	Court, Bulk purchase, KVK, Shakti sugar, hospital	Once in a month
9.	Cuttack	80 km	Bus	For collecting rice seeds from CRRI, Cuttack	Once in a year

Table 9: Problems identification of the village through RBQ technique for low cropping intensity and productivity of upland.

PROBLEMS	Rank I	II	III	IV	V	VI	R.B.Q(%)
(1) Farmers are traditionally rice growers, lack of knowledge about improved cropping system and crop diversification.	27	3	0	0	0	0	98.3
(2) Water scarcity, erratic monsoon and lack of residual moisture for sowing second crops.	1	17	1	7	7	0	65.8
(3) Non availability of inputs at proper time.	0	3	19	0	0	1	62.5
(4) Lack of high yielding, short duration pulses/oilseeds to be grown in upland.	0	6	6	5	5	3	53.6
(5) No soil and water conservation measures, improve cultivation practices like integrated nutrient, pest and weed management followed.	0	0	4	2	2	15	34.3
(6) Labour and grazing problem	2	1	0	16	16	11	33.3

themselves busy in collecting fuel wood and repair their houses. Some of them also migrate during summer to nearby towns or industries for daily wages. The daily routine diagram of young men and women of the village is given in diagram 10.

(18) Bio-resource flow diagram :

The farmer, Mr. Khatua has 1.5 acre of land under rice cultivation and 8 gunts under sugarcane cultivation. He is getting 12 quintal of paddy (Rs. 4800) and spends Rs. 1200 towards cost of cultivation. The income form the sugarcane crop is Rs. 8000 and he spends Rs. 4000 towards cost of cultivation. He has one deshi cow, yielding only a litre of milk per day. He is getting about Rs. 2500/- per annum from labour wages. On an average he gets 15 fruits from his jack tree, 10 kg drumstick from trees grown around the house. The bioresource flow chart is shown in diagram 11.

(19) Problem identification for research prioritization under rainfed upland ecosystem :

The problems for non adoption of improved cropping management practices were identified by rank based coefficient technique (RBQ) and are presented in table 9. Lack of awareness regarding improved cropping pattern, crop diversification and crop substitution was the main reason for low and unstable productivity of upland. The farmers are traditionally rice growers and cultivate only rice, even it fails frequently giving low and unstable yield. No soil and water conservation measures are adopted in the village and no improved method of cultivation like integrated pest and nutrient management, soil water conservation methods was followed.

RESEARCH PRIORITIES

I. 92% of farmers feel that rice in upland under rainfed farming is risky and results unstable yield. So efficient rainwater management through adoption of appropriate cropping pattern and crop diversification is the need of the hour. In this regard on-farm trials on crop diversification and substitution in upland with more remunerative crops like high yielding varieties of pulses and oilseeds are required. High yielding, short duration, low water requiring varieties of cereals, pulses and oilseeds and other inputs should be available in time.

II. Runoff recycling and water harvesting on watershed basis will provide irrigation source for supplemental irrigation to the crops at critical stages during *rabi* season.

III. Efforts should be made to improve the physical conditions of the soil and soil fertility through integrated fertilizer management like legume in cropping sequence/crop rotation or intercropping, green manuring, use of biofertilizer etc.

IV. Since weed in upland is a severe problem, integrated weed and pest management

through summer tillage, use of bio-agents in pest control, use of combination of biological and chemical weed control practices should be adopted.

V. Introduction of modern agricultural implements like tractor/power tiller, seed drill, seed drill–cum-fertiser drill on co-operative basis/custom hiring are needed for farm mechanisation, which will ensure timely agricultural operation reducing drudgery of farmers. Sowing of first crop should be adjusted with the onset of monsoon so that second crop can be grown successfully utilizing residual moisture.

VI. Priorities should also be given for better seeding and tilling practices to improve the existing sowing methods.

VII. Use of soil conservation measures viz., contour bunding, coservation tillage etc. and improvement of wasteland through adoption of alternate sustainable land use system like agro-forestry, silvipasture, horti-pasture, agro-silvi-culture etc. should be followed to reduce soil erosion and sustainable land resources development in upland where crop cultivation is not possible.

CONCLUSION

The PRA has really been proved an effective tool to get first hand information on available natural resources, technology adoption and rejection, problems and prospects of the farming community. It is helpful to exploit vast natural resources of region for better farm earning which could be achieved through proper generation of location specific technology, their extension, education and adoption of integrated farming. Our study reveals that rice in upland under rainfed farming was risky and resulted unstable yield. So efficient rainwater management through adoption of appropriate cropping pattern and crop diversification is the need of the hour. In this regard, on-farm trials on crop diversification and substitution of upland with more remunerative crops like high yielding varieties of pulses, cereals and oilseeds is required. Available excess rainfall should be harvested during *kharif* season to provide supplementary irrigation to the second crops to increase the cropping intensity of the area.

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