Indian J. Dryland Agric. Res. & Dev. 2014 29(2) : 93-99 DOI 10.5958/2231-6701.2014.01222.6

Livelihood Matrix and Technological Interventions for Efficient Farming Systems in Village Clusters of Gondia District of Maharashtra

A. Chaturvedi[1], N.G. Patil[1], T.N. Hajare[1], Arvind Mungole[2], L. Borkar[1] and Mamta Mokde[1]

[1]National Bureau of Soil Survey and Land Use Planning, Amravati Road, Shanakarnagar P. O. Nagpur-440 033, Maharashtra
[2]RTM Nagpur University, Amavati Raod, Shanakarnagar P.O. Nagpur-440 033, Maharashtra

Email: nitpat03@yahoo.co.uk

ABSTRACT: Research and development initiatives under National Agriculture Innovation Project implemented in representative villages of Gondia district in Maharashtra are reported in this study. Details of 524 households pertaining to demographic characteristics, land use, means of livelihood etc. were collected through survey. Participatory methods were used for identifying potential technological interventions for bringing positive changes in agricultural productivity and sustainability. The study indicated that irrespective of the size of land holding, the tribal farmers derived less than 50% of their income from agriculture and depended on migration for earning wages or collection of non-timber forest produce. The consumption pattern revealed that almost 80% of the income was spent on meeting food requirement of family followed by expenses on clothes. The results showed considerable potential for enhancing their livelihood by introducing best management practices for the lone possible *kharif* paddy and augmenting the income with pisciculture which surpassed agriculture in terms of economic benefits. Eco-friendly technology like biogas was demonstrated to protect forest resources and reduce drudgery of cooking. The concept of social security fund was implemented in the tribal villages to meet expenses related to upkeep of machinery provided and also micro-credit requirements. The study area represents contiguous belt home to most of the tribal population living in central India and hence the findings provide an understanding of the reasons for backwardness of the large pocket and will help in formulating policies for sustainable development of the region.

Key words: Tribal, livelihood, sustainable agriculture, natural resources, income

Rainfed agriculture in India is beset with the constraints imposed by uncertain monsoon, land degradation, inadequate resources and various socio-economic factors. In a less than normal monsoon year, additive interaction of these constraints often accentuates into devastating effect. The crippling effect may last for next 2-3 years and any gains made in subsequent years are invariably wiped out by a recurrence of poor monsoon. The cyclic nature of such events has been well understood and measures suggested after scientific studies have effectively proved that the damage in poor monsoon year can be minimized. To improve the livelihoods status in rainfed regions, the concept of sustainable livelihoods has gained increasing credence in research and development initiatives intended to improve agricultural productivity and poverty alleviation through development and managing natural resources (Chambers, 1987; Ashley, 2000). Livelihood status in rainfed regions faces problems like stagnating/declining resource use productivity, decreasing water availability and declining land-man ratio (Wani *et al.* 2000). The concept of sustainable livelihood is now recognized as focus area. Research and development initiatives under National Agriculture Innovation Project emphasize sustainable livelihood while tackling rural poverty alleviation through agriculture development and natural resources management. Development of harmonious relationship between the sources of livelihood and people residing in the agro-ecosystem is an underpinning base over which the strategies for economic development are planned. Participatory approach has been often preferred to identify the factors affecting sustainable rural livelihood (Ashley, 2000). The present study was conducted in one of the least developed districts of India. The district Gondia differs distinctly from other rainfed areas of the country because it is endowed with high rainfall (1400 mm in a normal year) and rich forest (44% area under forest). Further there are numerous small tanks to store water giving it recognition as 'district of tanks'. Paradoxically, 57% of the population in the district is categorised 'below poverty line' (Directorate of Economics and Statistics Report 2008–Maharashtra). For the last few years, different Government and other development agencies have effected some structural changes in the villages. Agricultural extension, rainwater harvesting, setting-up of residency schools, MGNREGA programmes *etc*. have helped in raising the livelihood status. This study was conducted in six representative villages under the aegis of National Agriculture Innovation Project to study the livelihood analysis of two selected clusters of Gondia district and diagnose the factors leading to poverty and limiting growth; and opportunity analysis with an aim to improve livelihood through natural resources based on livelihood options such as agriculture, pisciculture, non-timber forest produce *etc*.

Materials and Methods

Demographic characteristics of sample villages

The study area is located in tribal dominant Gondia district in the state of Maharashtra, India. It is enlisted in 150 least developed districts of India. Gondia as the name suggests it is inhabited by *Gond* tribe. The *Gond* tribe is relatively less affected by the caste system in the Indian society and Gonds pride themselves in the fact that they had their own kingdom and ruled sizeable part of central India and hence consider themselves as 'kshatriya' meaning warrior (considered upper caste in the hierarchy of Indian society), a privilege generally denied to tribes. One cluster of villages including Asalpani, Gonditimezari and Bagadband is located in Goregaon taluka, while the other cluster including

villages Salegaon, Khamtalao and Zunjaritola is in Deori taluka of Gondia district. Both the clusters are located in naxalite (a militant group that began as a socialist movement) infested area.

A baseline survey was conducted in the six selected villages during 2009 summer to collect information on current agricultural practices, crop yields, livestock, implements, equipments, credit availability, agriculture inputs used, animals, fodder needs, sources of income, literacy, consumption pattern, infrastructure, *etc*. Each household of the three villages was personally visited by a team of scientist, social worker, technical expert and NGO representative to collect the data. The questionnaire was prepared considering socio-economic conditions.

Soils and land use

The cluster landform consists of lower piedmont plain and narrow valleys surrounded by low hills. Soils are in general developed from mixed alluvium and/or granite/gneiss, micacious phyllites. Four soils were identified in the village namely, Typic Haplusterts, Typic Apisquerts, Typic Haplustepts and Vertic Haplustepts based on variation in topography. The soils in hilly region under forest are shallow to deep, excessively drained to well drained, acidic and have relatively higher organic carbon. These soils are classified as Loamy-skeletal, Typic Ustorthents, Lithic Ustorthents and coarse loamy Typic Haplustepts. Only one crop *i.e. kharif* rainfed paddy is grown in these villages. *Rabi* crop is usually not raised in the villages because soil moisture depletes rapidly and grazing by wild as well as domesticated animals is a big threat after rainy season. The research work was conducted in participatory mode (Chambers 1983) following standard tools like transect walks, formal and informal meetings, structured interviews, probing, mapping, diagrams, ranking and quantification, prioritization, stakeholder identification etc. After setting the priorities for development, possible interventions were discussed with the stakeholders and officials of line departments. The foremost priority as agreed by the villagers and researchers and officials was management of existing water resources since water shortage was the most significant factor that affected rice yields. The villagers knew of fellow farmers in nearby villages or relations owning irrigation wells, benefitting from timely transplanting. Opening of irrigation wells was ruled out due to 1) benefit to individual (rather than the community) alone 2) lack of financial resources 3) electrical power connection problems. The farmers also informed that traditional practice of storing rainwater in *"bodi"* (farm pond) helped them overcome dry spells but, it did not assure timely preparation of nursery. Early preparation of nursery and timely transplanting was identified as the most crucial management technique. However, lack of water resources and availability of only one tubewell in each village meant that nursery could be prepared at only one location for the entire village and that too if owner agreed to allow usage of his field and water.

Interventions based on baseline study started with optimum use of rainwater through timely seeding and transplanting in *kharif* season of 2009. In each village, one source of water was identified for this purpose. The water resource (tube-well) owner consented to provide water without cost/charges. Timely preparation of nursery allowed farmers to do transplanting at appropriate time (early July). Preparation of nursery bed, watering it, and other operations were done through voluntary/ community action.

Results and Discussion

Baseline survey

There were 128 households in Deori and 396 households in Goregaon cluster. Total population in Deori cluster was 768, while Goregaon had a population of 2668. The average family size in Deori cluster was comparatively small (6) than Goregaon cluster (6.7). There was substantial difference in literacy levels as Goregaon cluster showed greater literacy (53%) rate, six percentage points higher than Deori (47%) cluster. The literacy up to high school was better in Goregaon cluster (12% of the total population reaching high school level) compared to 2% population that went to high school in Deori cluster. The birth and death ratio (22 and 23) were almost identical in the clusters. The productivity of paddy in these villages is affected by intermittent dry spells during monsoon, low fertility of soils, and lack of soil and water conservation measures etc. Declining forest cover, shrinking grazing lands and conflicting interests in utilizing water in community tanks (CPRs) are other features. Productivity of livestock was poor. The villagers reported routine migration for seasonal employment. Land use analysis of the cluster villages indicates that forests dominate the landscape in the area. The land use pattern (Table 1) clearly suggested that Deori cluster was relatively better off with more irrigated area. However, the cropping intensity was poor underlining the fact that facility of irrigation was at best life saving or crop saving type and not adequate to increase cropping intensity or reasonably boost production. The rainwater stored in tanks serves irrigation purpose during dry spells of monsoon and the utility is restricted to only some parcels of cultivated area.

Table 1 : Land use pattern in the project clusters (year 2009)

Particulars	Area (ha)	
	Deori	Goregaon
Total geographical area	2215	2405
Forest area	1927	701
Permanent fallow	59	1149
Current fallow	19	0.8
Cultivable wasteland	61	29
Net area sown	111.5	186.8
Cropping intensity	102.51	100.4
Net irrigated area	23.6	13.2

In a survey of the entire population, it was observed that most of the farmers in the two clusters belong to marginal category; with only 0.5 ha land to till (Table 2). Goregaon cluster farmers were relatively poor with greater proportion of farmers in this category. Similarly, number of small farmers was almost identical in the two clusters (19 and 20); however Deori cluster had greater proportion of farmers in this category. In general, it was apparent that farmers in Deori cluster had greater land resources.

Comparison of average income (Table 3) obtained during the last three years also reflected the land holding pattern of the two clusters, with marginal farmers deriving almost 50% less income vis-à-vis semi-medium farmers. However, income reported by Goregaon farmers was higher than the Deori farmers despite lesser land holdings. Analysis of the source of income indicated that agricultural productivity was higher in Goregaon cluster evident from the relatively high income generated by farmers irrespective of land holding. However, Deori cluster farmers derived higher income from livestock in marginal category. In general, the total income of Goregaon farmers was higher than that of Deori farmers.

The farmers also derived substantial income from collection and sale of non-timber forest produce (NTFP) like mahua (*Madhuca latifolia*) flowers, gum, tendu (*Diospyros melanoxylon*) leaves, plates and cups made from leaves etc. The villagers were not willing to share information regarding income from NTFP due to persistent belief that the state could use it for displacing them or denying the usufruct rights. It is estimated that the annual income from NTFP per family ranged from ₹ 8000-10000. Thus, total annual income from all sources for marginal, small and semi-medium category ranged from ₹ 20000 to 63000. It could be surmised that the income from agriculture was lower than the income from wages earned through collection of NTFP.

The data on expenditure (Table 4) showed that irrespective of the category, the tribals, in Goregaon cluster spent most of the income on buying food (57 to 66%). Expenditure on clothes occupies second rank with 11 to 16% share. These two basic needs consume nearly 80%. Interestingly, semi-medium category spent 10% of the income on education (as against 5% by other two categories) proving well known dictum that increased income fuels desire for education. Expenses on health also increased on the category ladder with semi medium farmers spending relatively more amount. More or less similar pattern emerged from analysis of expenditure (Table 5) of Deori clusters. They spent greater proportion of income on food (59 to 70%) followed by the expenses on clothes (10 to 12%). Share of expenses on education and health increased with increase in income.

Table 2 : Land holding categorization of cluster farmers (year 2009)

Category of farmer	Deori			Goregaon		
	Number	Area (ha)	Average (ha)	Number	Area (ha)	Average (ha)
Marginal (< 1 ha)	30	15.0	0.5	63	28.1	0.5
Small (1 -2 ha)	20	30.5	1.5	19	29.0	1.5
Semi-medium (2-4 ha)	4	12.0	3	11	31.6	2.9
Medium (< 4-10 ha)	3	18.8	6.3	-	-	-
Total	57	76.3	1.3	93	88.7	1.0

Table 3 : Income (₹/year) from different sources in project clusters (year 2008)

Category of farmer	Crop		Wages		Livestock		Poultry		Total	
	Deori	Goregaon	Deori	Goregaon	Deori	Goregaon	Deori	Goregaon	Deori	Goregaon
Marginal	5996	6200	2985	4131	2102	1826	32	55	11115	12212
Small	9615	10219	2802	3966	5216	6482	80	120	17713	20787
Semi-medium	11818	12224	1285	2011	11035	13869	149	177	24287	28281
Medium	17069	-	1485	-	25639	-	266	-	44459	-

Table 4 : Consumption/expenditure pattern of Goregaon cluster (year 2008)

Particulars	Marginal	Small	Semi-Medium	Average
Food	13792	16824	20615	17077
Education	768	1201	3642	1871
Medical	1312	1291	3663	2089
Maintenance of vehicles	145	125	160	143
Maintenance of house/cattle shed	386	328	468	394
Maintenance of household equipments	135	161	212	169
Clothes	3546	3295	4135	3659
Electricity bill	512	454	664	543
Water bill	91	108	119	106
Social functions	689	1196	2229	1371
Any other	142	377	257	259
Total	21521	25361	36164	27682

Rainfed paddy is the only crop grown during *kharif* season in the villages. The survey findings indicated that average productivity was 16.2 q/ha. Each village had one tubewell owned by an individual farmer. There were 16 open wells but these wells served as source of drinking water alone. Tubewell owner irrigated 5-6 acre area which could increase to 10 acre depending on the agreement between well owner and the plot owner. Crop sharing agreement or tenancy agreement was renewed every year. However, such activities were negligible as tubewell owners reportedly struggled to meet their own irrigation requirements. The farmers were not keen on *rabi* crop because of the threat from wild animals during winter season.

Table 5 : Consumption/expenditure pattern of Deori cluster (year 2008)

Particulars	Marginal	Small	Semi-medium	Medium	Average
Food	12587	14854	18274	22720	17109
Education	620	1022	2786	1400	1457
Medical	822	987	2655	4108	2143
Maintenance of vehicles	97	95	76	128	99
Maintenance of house/cattle shed	237	358	370	505	367
Maintenance of household equipments	93	121	156	162	133
Clothes	2197	2573	3845	3999	3153
Electricity bill	314	406	766	815	575
Water bill	66	89	79	101	84
Social functions	889	602	1691	2913	1524
Any other	78	165	193	255	173
Total	18002	21271	30892	37106	26818

Technological interventions

Interventions related to two important natural resources namely, soil and water are discussed below. The interventions were planned in consultation with the expert group and farmers who provided their preference in utilizing these resources. Participatory methods (a demand-driven process, where the end users participate in the design and implementation) were used to identify the factors affecting sustainable rural livelihoods. Water management interventions included ground water usage in participatory mode, rainwater management for optimum utilization through crop husbandry and fish farming in surface water bodies.

Utilizing water resources-rainwater management through community nursery

The only possible crop in cluster villages during *kharif* season is paddy because of the high rainfall. The analysis had revealed that farmers wait for onset of monsoon and seeding of paddy nursery is done only when they see clear signals of monsoon arrival. First 2-3 spells of monsoon are often ignored as the spells could be very short and dry spell could follow ruining the nursery. The practice is time tested and based on decades of experience. The seeding is thus done by late first week of July and hence the transplantation is done during last week of July and extended till mid-august. The rainfall distribution pattern clearly shows that the amount of rainfall received during June, July, August and September corresponds to 64, 415, 500 and 213 mm (long term average as computed by Indian Meteorological department 2009). The wettest period in the region occurs during the months of July and August. But, the paddy crop transplanted during late July and August is too young to utilize the available moisture to an optimum extent. The key intervention was therefore to utilize rainwater to an optimum extent by ensuring that the crop is more than a month old during wettest period. It was planned to prepare nursery well in advance and ensure transplanting by the first fortnight of July 2009. Obviously, groundwater was essential for nursery preparations. Further, the onset of monsoon was delayed in year 2009. As a consequence, the farmers were grappling with drought. However, each village had one privately owned tubewell. In a participatory approach, a meeting was held with the farmers in each village. The owner of tubewell was requested to provide water for paddy nursery. The beneficiary farmers (around 25 in each village) agreed to compensate the water provider with physical labour. Total of 150 farmers spread in six villages of the two clusters were brought together for community action. Thus, a community nursery was prepared in each village and transplanting was done at least two weeks earlier than the routine practice. Because of this intervention, following changes took place in paddy cultivation practices.

- Seedlings were ready for transplanting at the on-set of monsoon
- Protection from early cessation of rains/moisture shortage
- Early *kharif* harvest and availability of adequate soil moisture for *rabi* crop

Another key intervention was adoption of best management practices for paddy crop. The traditional practice of transplanting 10 or more plants per hill was strongly discouraged and only 2-3 seedlings were planted per hill. Thus, the seed rate was cut by 60-80% (₹ 540/acre). It is estimated that in seed cost alone, the community saved ₹ 81000 during 2009 for 150 acre area. The fertilizer schedule recommended by local university was followed. It was impressed upon the farmers that the fields need not be ponded all the time and during three dry spells of the season, they were persuaded not to irrigate and instead follow wet regime practices of system of rice intensification (SRI) technique. Cono weeder was used for weeding operations. The best management practices were thus adopted to solicit compliance. The results of interventions indicated that paddy yields had gone up substantially (Table 6). The yield advantage ranged from 56 to 112%. If the results could be replicated in rest of the district, even a conservative estimate shows an increase in the rice yields enough to cause a change in living standards of the tribal farmers. Agriculture possibly would become a serious enterprise. As a consequence of rainwater management (early nursery leading to early transplant and early harvest leaving residual soil moisture), *rabi* crops were raised for the first time in these villages. Interestingly, the farmers were reluctant to grow *rabi* crop due to perceived grazing threat from their own kin (cattle holders) and wild animals. Another hindrance was the reluctance to deviate from traditional practice of migration after *kharif* season. Again a community action helped to solve the problem. The farmers agreed to supervise fields on rotational basis for crop protection.

Rabi (second crop) interventions

Because of early harvest of paddy crop, the farmers could for the first time in their living memory plan a *rabi* crop. The soil moisture content in general was not adequate to grow second crop on residual moisture. However, the possibility of second crop alone enticed the farmers to try bengalgram, one of the pulses that fit into their diet requirements. The crop was grown in 75 ha area by 180 farmers. Normally, field preparation (for next crop) after paddy harvest is not done till the month of

Table 6 : Rice yields obtained by tribal farmers after scientific interventions

Variety	Average yield over last 20 years (q/ha)	Variety demonstrated	Number of farmers	Grain yield during 2009 (q/ha)	Advantage accrued (%)
Local varieties marketed by private enterprises (e.g. Ruchi, JGL, 1010)	16.2	Khamang	36	34.40	112
		Sindewahi-1010	22	29.10	79
		HMT	36	25.30	56

May next year by the farmers. Because of the single seasonal crop regime, the farmers are not habitual with tilling the fields second time in one year. Moreover, they believed that clods conserve moisture and hence need not be disturbed. In the first year of interventions, the farmers could not be persuaded to prepare field for sowing second crop. The bengalgram crop was sown by broadcasting method. Other crops like lathyrus, linseed, safflower, *etc* as detailed in Table 7 were also grown by enterprising farmers willing to experiment. A group of 35 farmers raised watermelon crop in beds of water tanks after water had receded at the end of monsoon. Only five farmers adopted line sowing method. The crop yields (Table 7) were not appreciable but, the farmers were happy as they could meet the pulses requirement of the family. Further, the *rabi* season kept the farmers engaged gainfully employed relieving pressure on forest resources for living.

Utilizing surface water resources

In another water management related intervention, one surface water body available around each village was identified as crucial community property resource for sustainable livelihood. The Joint Forest Management Committee (JFMC) constituted in each village, had acquired rights of fishing in the forest department owned tanks adjoining the villages. However, lack of skills in fish farming as well as co-operative management prevented optimal utilization of the rights. In fact, none of the JFMC was functional. In a related demonstration, eighteen farmers were selected by the villagers (Salegaon village) in a meeting that applied criteria of choosing the potentially adept person to acquire fish farming skills. JFMC permitted them to exercise fishing rights in its tank spread over 5 acre. This group of 18 persons was trained in pisciculture at state run training centre. The group was also provided with fingerlings (82000) and fries (84000) in proportion of Katala (40%), Rohu (35%), and Mrigal (25%). The farmers could not purchase fish feed due to lack of resources. However, the watch and ward was done meticulously and they harvested 2.32 t fish in the first year. Lack of proper fishing equipments prohibited optimum harvest and it was estimated that approximately 2.0 t fish could be harvested. Thus, ₹ 139000 was realized and potentially an almost identical amount of fish remained in the tank. The per capita income of ₹ 7722 encouraged the villagers to take up pisciculture as a serious community enterprise. It was apparent that stress on forest resources for living was substantially reduced as the fishing group stayed away from collecting NTFP.

Other interventions

Tribal living in forest area is often accused of exceeding permissible limits of fuelwood collection. The interests of environment protection and livelihood of tribal thus conflict with each other. Many tribal people own animals (bullock & milch animals) and adequate quantity of dung is available in many households that could be a potential source of energy. There have been many efforts by Government to popularize gobar/dung gas plants. However, such gas plant is perceived to be expensive, high on maintenance and space consuming technology. The villagers lamented that minimum of four adult animals were required to keep the gas plant running. A cheap unit developed indigenously that uses plastic bag for storing generated gas was offered and twenty villagers have adopted it successfully. A new methodology of setting up the gobar (balloon) gas unit was introduced which required minimum skills. The materials required are good quality plastic sheet, 2 plastic pipes for inlet and outlet pipes (3-4 feet long with diameter of 2.5 cm) and a valve to regulate the flow of gas, a gas burner/stove and pipe to carry gas from the balloon to the gas stove. The daily consumption of fuel wood in the household is about 8 kg of dried wood, which means that one tree of 5 years age is lost per day for meeting fuel wood requirement. Thus, seemingly small technology makes a big difference and impact. In addition, there has been enhancement of income as the time spent on fuelwood collection was utilized for NTFP collection. The dependence on forest for fuelwood was thus demonstratively reduced.

Often successful adoption of technology becomes short-lived and farmers revert to the traditional methods once the scientists/ experts withdraw from the project village. Therefore, need based informal groups were formed in each cluster. Social security fund was created with ₹ 411/- contribution from each farm family and deposited in nationalized bank jointly with villagers (2) and NGO representative (1). The fund is expected to meet expenses in future that would arise for communication with experts, purchase of relevant inputs/equipments for community use, maintenance of assets that are being created etc. Part of income earned by pisciculture farmers was set aside and the fish seed cost during the year 2010 was born by the user group. The project was implemented in transparent manner and following points were scrupulously followed to keep the interest of the farmers.

Table 7 : Crop yields during *rabi* season of 2009-10

Crop interventions	Number of households	Area (ha)	Yield (q/ha)
Bengalgram	180	75	4.7
Lathyrus	2	1	2.5
Linseed	2	1	3.7
Safflower	2	1	2.6
Lab-lab	2	1	5.0
Paddy (*rabi*)	2	1.2	3.1
Watermelon	35	2.4	5.0

- Register for service delivery receipts maintained at village level supervised by village committee.
- Bank account passbooks for Commodity Interest Group (CIG) accessible to all.
- Participatory and transparent selection of beneficiaries for technological interventions.
- List of development partners/beneficiaries in the cluster displayed prominently.
- Inspection reports from field staff regarding received materials maintained transparently.
- Diary of schedule of activities for development partners.

The interventions in the selected villages have provided alternative opportunities of livelihoods to the farmers. Results also provided an interesting insight to the problems bequeathed by the farmers in a given system and possible means for developing sustainable rural livelihoods.

Lessons learnt

- Community managed paddy nursery, pisciculture, forestry programmes need to be encouraged.
- Rainwater harvesting and its use efficiency should be accorded a priority in agricultural development along with supplementary/allied enterprises.
- Networking of farmers on the line of SHGs, and social security fund should be promoted to make agriculture more productive and remunerative.
- Off-farm livelihood activities need to be promoted especially during summer season.
- Efficient use of NTFP to supplement income from agriculture need to be further explored and strengthened.

Conclusions

The livelihood study was conducted in the easternmost corner of the Maharashtra state, adjoining tribal pockets of Telangana, Chhattisgarh and Orissa. The contiguous belt is home to most of the tribal population living in central India and hence the findings provide an understanding of the reasons for backwardness of the large pocket. It would help in formulating policies for development of the region. The study demonstrated that agriculture in isolation can't be a source of sustainable livelihood and is one of the components relegated to third or fourth position in terms of income. The policy of extension must realize this fact. Community action is necessary even for crop-specific technology adoption and mitigating droughts or drought like situation. Further, fish farming and agriculture must be integrated in these parts to augment income of tribals. Rules governing processing of non-timber forest produce especially mahua need to be revised to enable market advantage in favour of tribals. Forest department thus needs to play an important role as they have major stake in sustainable income of tribal farmers.

Acknowledgement

The authors acknowledge the assistance rendered by World Bank through the National Agriculture Innovation Project of Indian Council of Agricultural Research. The work reported here was conducted as a part of sub-project entitled-Efficient Land Use Based Integrated Farming Systems for Rural Livelihood Security.

References

Ashley 2000. Applying Livelihood Approaches to Natural Resources Management Initiatives: Experiences in Namibia and Kenya. Working Paper 134; Overseas Development Institute, U.K.

Chambers R. 1983. Rural development: Putting the last first. London: Longmans.

Chambers R. 1987. Sustainable livelihoods, environment and development: putting poor rural people first. IDS Discussion Paper no. 240, University of Sussex, Institute of Development Studies, Brighton, UK, 37 pp.

Directorate of Economics and Statistics Report 2008 available at https://mahades.maharashtra.gov.in

India meteorological department 2009. Available at http://www.imd.gov.in

Wani SP, Pathak P, Tam HM, Ramakrishna A, Singh P and Sreedevi TK. 2002. Integrated Watershed Management for Minimizing Land Degradation and Sustaining Productivity in Asia. In Integrated Land Management in Dry Areas. Pages 123-147 in Proceedings of a Joint UNU-CAS International Workshop (Zafar Adeel, ed.), Beijing, China.8-13 September 2001.

Received: November 2012; Accepted: December 2014