International Journal of Geology, Agriculture and Environmental Sciences
Volume – 3 Issue – 4 August 2015
Website: www.woarjournals.org/IJGAES *ISSN: 2348-0254*

Evaluation of Energy Production in Badadhuleswar Village Ecosystem of Cuttack District in the Bank of River Mahanadi, Odisha, India

Amarnath Sahoo[1], Malaya K. Misra[2], Birendra K. Bindhani[3]*

[1]Department of Botany, Stewart Science College, Cuttack, Odisha, India

[2]Department of Botany, Berhampur University, Odisha, India

[3] Assistant Professor – II, School of Biotechnology, KIIT University, Campus-XI, Patia, Bhubaneswar
Pin - 751024. Odisha, India,Mobile: +91 9437607161
Phone: 0674 - 2725466; FAX: 0674-2725732

Abstract: ***Natural resources are being continuously exploited and suffer degradation due to high human and livestock population density as well as poor management. Total village ecosystem was investigated in Badadhuleswar, a smal1 village ecosystem in Baiyalish Mouza situated in the bank of river Mahanadi of Cuttack district, Odisha, India. Badadhuleswar village has population of 1159 of which 600 are males while 559 are females as per Population Census 2014. Approximately 19% of the men are involved in secondary occupations such as fishing and other agro-based industries. About 75% of the women work: agriculture (33%), labour (37%) and others (5%). The number of land-owning farmers has increased by 76% whereas that of landless labourers has decreased by about 24% over the past 10 years. Paddy is the major crop of Badadhuleswar, currently grown on 128 ha (55% of the total). The crop is primarily rain fed and cultivated during kharif with ponds as an additional source of irrigation.***

Keywords: Ecosystem, Agriculture, Crop Production, Rain fall, Energy Production.

1. Introduction

Badadhuleswar is small village located in Baiyalish mouza of Cuttack Sadar Block of Cuttack district, Orissa with total 245 families residing. The Badadhuleswar village has population of 1159 of which 600 are males while 559 are females as per Population Census 2014 [1-4].

In Badadhuleswar village population of children with age 0-6 is 115 which make up 9.92 % of total population of village. Average Sex Ratio of Badadhuleswar village is 932 which is lower than Orissa state average of 979. Child Sex Ratio for the Badadhuleswar as per census is 597, lower than Orissa average of 941.

Badadhuleswar village has higher literacy rate compared to Orissa. In 2014, literacy rate of Badadhuleswar village was 88.03 % compared to 72.87 % of Orissa. In Badadhuleswar Male literacy stands at 91.86 % while female literacy rate was 84.11 %.

As per constitution of India and Panchyati Raaj Act, Badadhuleswar village is administrated by Sarpanch (Head of Village) who is elected representative of village. Schedule Caste (SC) constitutes 22.69 % while Schedule Tribe (ST) was 9.75 % of total population in Badadhuleswar village.

In Badadhuleswar village out of total population, 386 were engaged in work activities. 87.05 % of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 12.95 % were involved in Marginal activity providing livelihood for less than 6 months. Of 386 workers engaged in main work, 30% were cultivators (owner or co-owner) while 70% were Agricultural laborers.

The aim of the present study is to evaluate the relationship between the village ecosystem of Badadhuleswar, situated in bank of river Mahanadi, Odisha and the agriculture resources in terms of biomass and energy in village ecosystem with reference to land use, productivity, consumption and import-export status of biomass resources.

2. Methods

The following methods, which are based on the guidelines and protocols developed by the Centre for Sustainable Technologies, Indian Institute of Science, were adopted.

1.1. Secondary Records were consulted to obtain general information about the village, including demography, rainfall, past land-use, cropping pattern, irrigation and livestock. The information was gathered from different departments such as Cuttack Sadar Tahasil and Bentkar panchayat.

1.2. Field Studies: They are given below and which were conducted to gather information on different resource indicators of the village ecosystem.

1.2.1. Land Survey: The land was surveyed to demarcate and map of current land-use systems, cropping pattern and irrigation sources. A map prepared in 2014 was digitized and used as the base map to demarcate current land-use. Latitudes

and longitudes of strategic locations were ascertained and recorded. Land history was recorded wherever available.

1.2.2. Soil and Water: Soil samples were collected representing major land use and cropping systems and samples of drinking water were collected from major drinking water sources.

1.3. Household Survey: It was undertaken to obtain additional information on cropping methods, fertilizer and manure application, water and fuel sources, consumption pattern, etc.

1.4. Participatory Rural Appraisal: It was carried out to understand community perception of the status and trends in various resources, the usage patterns and the factors for changes, if any.

1.5. Laboratory Measurements: They were made to determine the status of soils from different land use systems and the quality of drinking water from different sources.

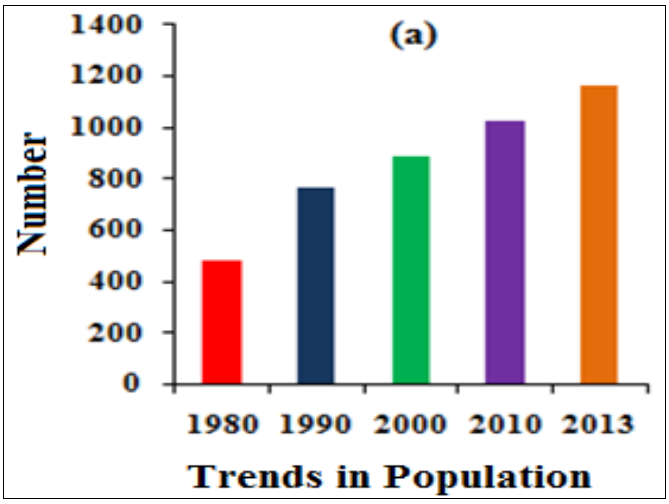
The inventory was carried out from October 2012 to February 2013, which is referred as the current period in this report. The land-use and cropping particulars are of kharif, the main cropping season (conducted during the harvesting period

The village area and land classification data were obtained from Revenue and Forest records confirmed through cross-checks in some cases. Al1 the households of the village were considered for the study.

3. Results and Discussions

3.1. Trends in Number of Population and Households

The current population of the village is 1159, comprising 600 men, 559 women and in 245 households. There has been an increased trend in the population of the village over the past three decades. The number of households has also increased over the past 25 years. Trends of increase are mainly driven by fragmentation of families, abandonment of agriculture in a few cases and migration in search of livelihood opportunities (Figures 2a and 2b).



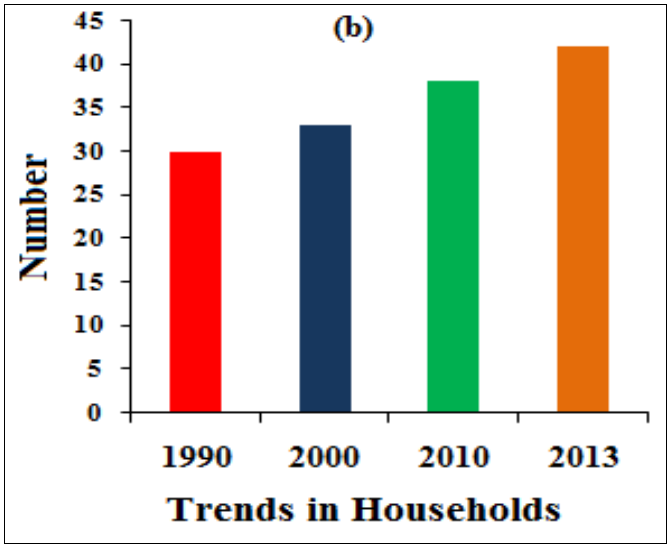


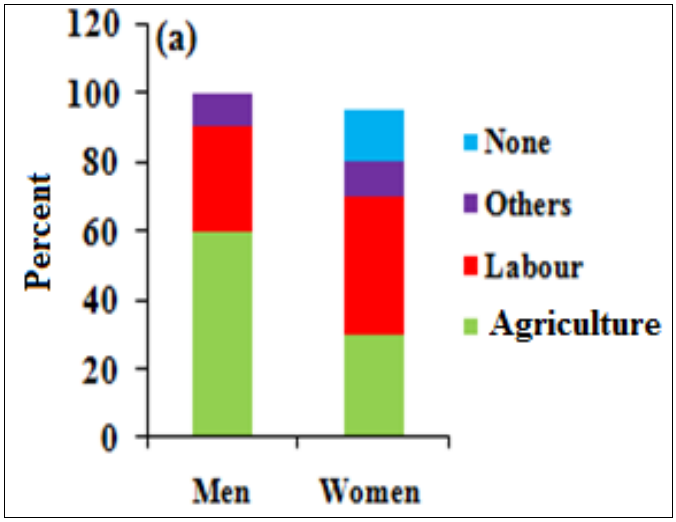
Figure 2: Trends in Population (a), Trends in Number of Households (b)

3.2. Land Holding and Occupation

Agriculture is the primary occupation of about 46% of the households in Badadhuleswar and 48% are involved in agriculture-related businesses. About 50% of the farmers are categorized as medium farmers (holding 3–10 acres); 25% are large farmers (holding more than 10 acres) and 21% are small farmers (holding less than 3 acres). About 5% of the households are of landless labourers. Most of men in the village are engaged in agricultural activities; about a third is labourers. Approximately 19% of the men are involved in secondary occupations such as fishing and other agro-based industries. About 75% of the women work: agriculture (33%), labour (37%) and others (5%).

3.3. Trends and Implications

The number of land-owning farmers has increased by 76% whereas that of landless labourers has decreased by about 24% over the past 10 years. The increase in the number of medium farmers can be attributed to fragmentation of land holdings. Migration for employment and better income has led to the decline in the number of agricultural labourers leading to labour scarcity (Figures 3a and 3b).



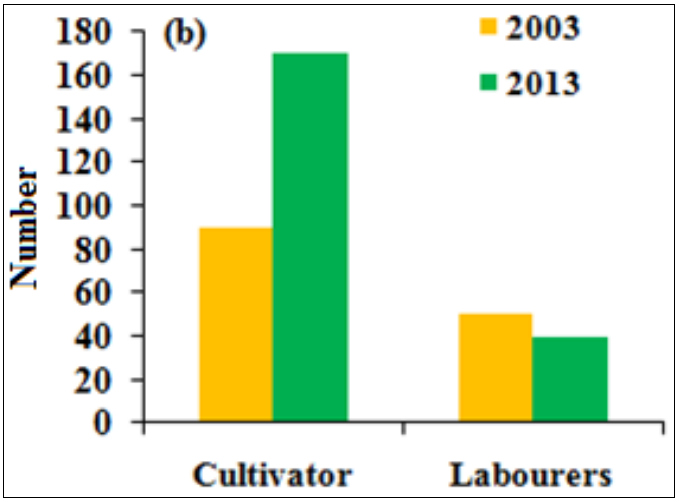


Figure 3: (a) Current Occupation Status (Percent Households) and
(b) Trends in Population involved in agriculture and Labours.

3.4. Rainfall Trends

Most of the rainfall is received during the monsoon, July and August being the peak months. The rainfall is quite high since the village is located in the Eastern Ghats high-rainfall zone. The mean annual rainfall of Badadhuleswar is about 3000 mm. Annual peak over the years is showing shift towards September which is significant in year 2010 and 2013 (Figures 4a and b).

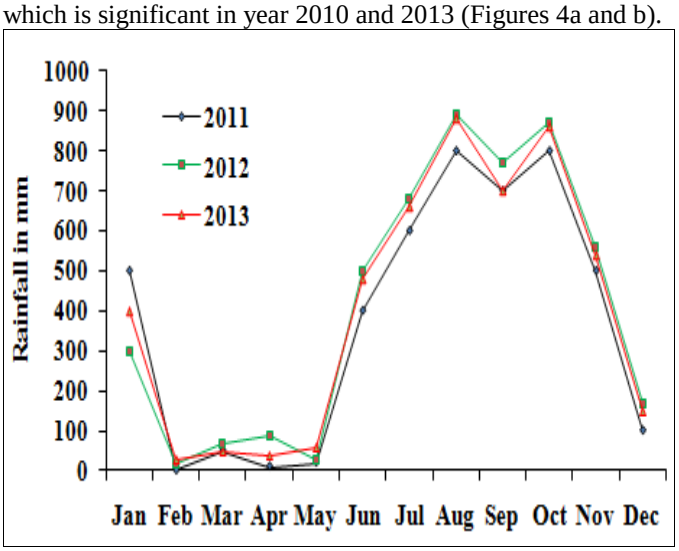


Figure 4a: Trends in Monthly Rainfall

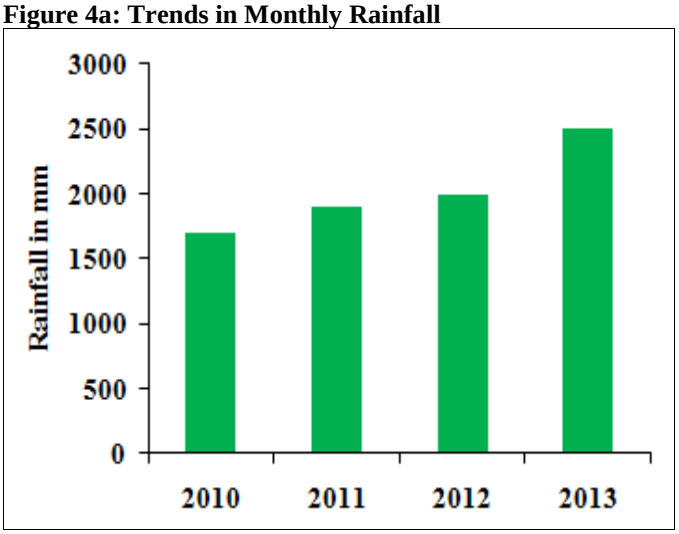


Figure 4b: Trends in Rainfall

The region experienced drought from 2012 to 2013, which affected agricultural activities in the region. However, above-average rainfall in the past couple of years has led to revival of agricultural activities. The average minimum and maximum temperatures of the region are 19 °C and 39.1 °C [5].

Major land-use systems in the village include cropland, water bodies, wasteland and grazing land. Cropland (250 ha) accounts for 46% of the total area of the village. Ponds (70 ha) account for 24% and other land categories including wasteland (40 ha) and grazing land (80 ha) account for the remaining 20% of the total area.

3.5. Cropping Calendar

The cropping pattern of the village consists of both perennial and annual crops. Perennials or plantations mainly include sugarcane. Paddy is the major annual crop. Currently paddy is cultivated as a kharif crop, depends mainly on rains. Due to non-availability of irrigation during summer, paddy is not cultivated in the second season i.e., Rabi.

3.5.1. Current Status

Paddy is the major crop of Badadhuleswar**,** currently grown on 128 ha (55% of the total). The crop is primarily rainfed and cultivated during kharif with ponds as an additional source of irrigation. Sugarcane is the second major crop, currently cultivated on 94 ha (41% of the total); 27 ha of these support such inter crops and mixed crops as paddy, banana, vegetables and turmeric etc.

3.5.2. Trends

Agricultural activities in Badadhuleswar have been fluctuating over the past two decades. In a few cases, agricultural lands have been abandoned and plantations established. Such changes may be due to factors such as shortage of labour, increased cost of cultivation and price fluctuations [6]. Area under sugarcane has increased three fold over the past three decades. Sugarcane is fast replacing paddy, area under which has been fluctuating owing to non-availability of irrigation. About 20 years ago, paddy was cultivated twice a year, as a rainfed crop in kharif and irrigated with pond water in Rabi. Currently the ponds are silted and farmers are forced to depend on rains and harvest only one crop a year (Figure 5).

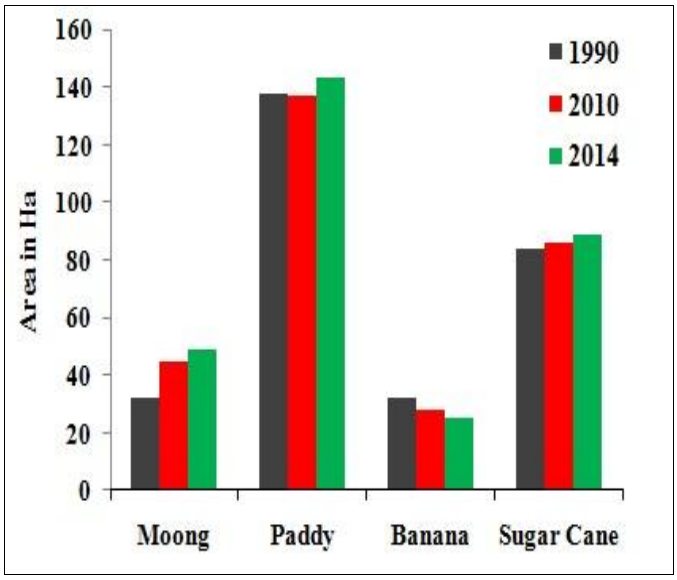


Figure 5: Trends in Major Crops

3.6. Crop Varieties

Paddy varieties currently cultivated include Rajlaxmi (Hybrid), Ajay (Hybrid), Swarna, Gayatri, Sahavagi Dhan, Naveen, Haneswari, Varshadhan, Sarala and Padmini. Sugarcane variety cultivated is local. There has been a gradual change in the varieties of paddy being cultivated. Varieties cultivated 10–15 years ago included Swarna, Gayatri and Varshadhan; farmers now prefer improved varieties for higher yields and returns.

3.6.1. Pests and Pest Control

Blast of paddy, a fungal disease, is the major disease; it was reported by 52% of the cultivating households. Aphid infestation was reported by 9% of the responding households whereas 22% of the responding households reported no pests. The major disease of sugarcane are Early shoot borer, Inter-node Borer, Top Borer, Whitefly, Red Rot, Smut, Termites, Pyrilla, Scale insect, Ratoon Stunting Disease, Leaf Scald.

Control measures adopted for blast of paddy include application of pesticides such as enosan and democran. DuPont™ Ferterra® (chlorantraniliprole 0.4% GR) insecticide, is an insect control compound for sugarcane pest management from a new class of chemistry, the Anthralinic Diamides. When used early in the pest life cycle, Ferterra® prevents the buildup of pest population and maximizes the crop yield potential. Usually a precautionary spray is given before the rains and once infection is observed, three to four rounds of DuPont™ Ferterra® (chlorantraniliprole 0.4% GR) insecticide application are undertaken. Organic pesticides such as neem cake and neem oil are also used for Early/Shoot/Internode borer diseases in a few cases.

3.6.2. Fertilizer and Manure Application

Fertilizers are applied in larger doses for paddy (0.5 t/ha). On the other hand, paddy gets greater quantities of organic manure (4.7 t/ha) than other crops. There has been a drastic reduction (about 91%) in the application of organic manure to the croplands [6-8].

3.6.2. Trends in Crop Yields

Half of the sugarcane cultivating households reported reduction in yield over the past 5–10 years, 38% reported an increase and the rest reported no change. The reduction in yield can be attributed to borer infection, which can reduce yields by up to 21%. In the case of paddy, 36% households reported increased yields, an equal proportion reported no change and the rest 28% reported reduction. Increase in yield can be attributed to such high-yielding varieties as Gayatri and Varshadhan.

3.7. Composition and Trends

The current livestock population of the village is 254, comprising cows (72%), bullocks (9%) and buffaloes (19%). There are no cross-bred cattle or sheep or goats in the village. The population of livestock has decreased drastically, by over 40%, during the past two decades, driven mainly by reduced agricultural activity, decreased population and conversion of dedicated grazing lands to plantations leading to reduced availability of fodder (Figure 6).

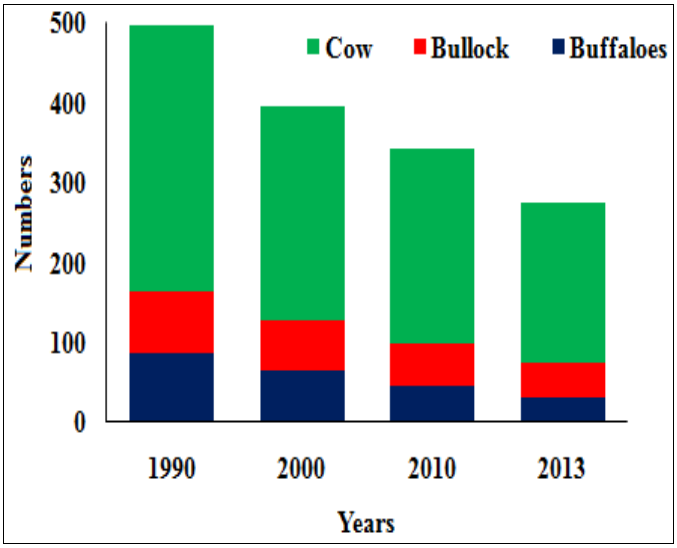


Figure 6: Trends in Livestock population.

3.8. Grazing Pattern and Dung Production

Grazing is practiced mainly location for livestock during the cropping season. After the crop is harvested, livestock depends on the harvested croplands or on stall feeding. Paddy straw is the major source of fodder in the village after the harvest. Annually about 3.5 tones of dry fodder is required per head of cattle. Although no fixed hours are allotted for grazing, cattle usually graze for about 8 hours a day.

Each cow and buffalo produces on an average 13 kg and 15 kg of dung a day respectively whereas each bullock produces about 8 kg. There is very little scope to establish a community-scale biogas plant in the village. However, where there are enough animals to meet the minimum dung requirement of a biogas plant, a few home-scale units can be established.

3.9. Soil Quality

Soils of Badadhuleswar are mainly a mix of black soils and red soils. In paddy and sugarcane lands, organic carbon content was medium. Lower levels of organic carbon in croplands can be attributed to intensive cultivation practices whereas village forests recorded highest levels (1.5%) due to undistributed soils. The abandoned sugarcane plantations also recorded high levels (1.4%). Soils under both sugarcane and paddy recorded comparable bulk densities, pH values and available potassium content. Bulk density ranged from 1.36 to 1.37 g/cc. The soils are moderately acidic, with sugarcane recording 5.9±0.4 and paddy 5.6±0.5. Soils are rich in available potassium: 271.81 and 276.31 kg/ha in sugarcane and paddy soils respectively (Table -1).

Table.1. Cropland Nutrient Status

Cropland Nutrient Status		
	Sugarcane	**Paddy**
Percent Organic Carbon	**0.46**	**0.53**
Bulk Density in g/cc	**1.31**	**1.33**
PH	**5.83**	**5.52**
Available Potassium in kg/ha*	**270.80**	**274.31**
Available Sulphur in kg/ha	**13.80**	**14.62**

***<50 low; 50-120 medium; >120 High**

3.10. Irrigation Sources

Agriculture in Badadhuleswar is mainly rainfed. Canals and ponds form the major irrigation sources. Groundwater sources such as open wells and bore-wells meet 8% of the irrigation requirements. Pond water irrigates another 8% of the croplands. The community is, therefore, dependent on rains and alternative sources such as canals and ponds for irrigation, which makes agriculture vulnerable to water stress. Paddy is basically rainfed in kharif, and rabi paddy is dependent on pond irrigation. Borewells and open wells meet the water requirements of sugarcane in summer to some extent.

4. Conclusion

Badadhuleswar agricultural ecosystem has undergone significant changes owing to changes in availability of water for irrigation, labour scarcity and deficient rainfall over the past 5–10 years. Paddy, a commercial crop cultivated in the past, has been abandoned as a result of deficient rainfall and labour scarcity. Dependence on agriculture as a primary occupation has declined over the years. Population of Badadhuleswar has decreased and people are looking for alternative sources of incomeThough there is increase in the population, there is labour scarcity within the village and people depend on labour from neighbouring villages paying them higher wages. There have been significant changes in land-use over the past ten year with fluctuations in net area cultivated, which is largely driven by deficit rainfall and loss of grazing lands. Monoculture plantations of Acacia have been raised on lands that were set aside for grazing in the past. Livestock population has declined significantly, again as a result of decreased availability of labour, smaller population and, of course, loss of grazing lands. Soils are acidic and generally low in organic carbon, indicating intensive cultivation and disturbance.

5. Acknowledgements

The first author thanks to the villagers of Badadhuleswar of Cuttack District for their cooperation in providing information. The authors also thank to Head of the Department of Botany, Berhampur University for providing necessary laboratory facilities, kind supports and courage gives for this work to be successfully completed.

References

[1] Mohanty, A. K. "Cuttack: City of the Fort". Orissa Review, 2000, 36–40.

[2] Mohanty, P. K. "Cuttack: Carrying the Heritage of Orissa" (PDF). Orissa Review, 2007, 63 (1): 57–61.

[3] Mahanadi River (River, India) - Encyclopedia Britannica, 27.06.2015

[4] Cuttack Approved – N at GEOnet Names Server, United States National Geospatial-Intelligence Agency.

[5] Dash, S. S., Misra, M. K. Studies on hill agro-ecosystems of three tribal villages on the Eastern Ghats of Orissa, India. Agriculture, Ecosystems & Environment, 2001, 86 (3), 287 – 302.

[6] Naidu, S. J., Misra, M. K., Production and consumption of wild date palm sap and country liquor in two tribal village ecosystems of eastern Ghats of Orissa, India, Bioresource Technology, 1998, 63(3), 267-273.

[7] Mohanty, R. K., Verma, H. N., Brahmanand, P. S. Performance evaluation of rice-fish integration system in rainfed medium land ecosystem, Aquaculture, 2004, 230 (1-4), 125 – 135.

[8] Nayak, S.P., Nisanka, S. K., Misra, M. K. Biomass and energy dynamics in a tribal village ecosystem of Orissa, India, Biomass and Bioenergy, 1993, 4(1), 23-34