

The background of the cover features a close-up, slightly blurred image of a calculator with blue and black keys, and a portion of a banknote with a green seal and some text. The overall image is framed with rounded corners.

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ARTICLES

Review

- Green banking in India** **1**
Suresh Chandra Bihari* and Bhavna Pandey

Research Articles

- Effect of climate change on food crop production and vulnerability assessment in Oyo State** **18**
S. A Adewuyi*, B. Folorunso, L.O Okojie and D. Akerele

Review

Green banking in India

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Environmentalism is a social movement that shows the concerns for environmental conservation and improvement of the state of the environment. This has now become a constant concern in every industry and it is no wonder that the banking industry also caught the 'green' fever. To circumvent the global warming trap, the impulse of 'going green' is running faster than expected amongst all the big giant industries, from Mutual Funds to Banks; every industry is moving fanatically ahead with its own green initiatives.

Key words: Environmentalism, industries, green banking, banking sector, environmental friendly.

INTRODUCTION

"Earth provides enough to satisfy every man's needs, but not every man's greed."

— Mahatma Gandhi

The banking industry influences economic growth and development, both in terms of quality and quantity, leading to a change in the nature of economic growth. Therefore, banking sector plays a crucial role in promoting environmentally sustainable and socially responsible investment. Banks may not be the polluters themselves but they usually have a banking relationship with some companies/investment projects that are polluters or could be in future.

Therefore, banking sector plays a crucial role in promoting environmentally sustainable and socially responsible investment. Banks may not be the polluters themselves but they usually have a banking relationship with some companies and their projects- polluters or could be in future.

Banking sector is reckoned as environmental friendly in terms of emissions and pollutions. Internal environmental impact of the banking sector such as use of energy, paper and water is comparatively low and clean. Environmental impact of banks is not physically related to the banking activities but with its customer's activities. Therefore, environmental impact of bank's external activity is huge, though difficult to estimate.

Environment management in the banking business is considered likely to be risk management. It increases the enterprise value and lowers loss ratio as higher quality loan portfolio results in higher earnings. Therefore encouraging environmentally responsible investments and prudent lending should be one of the responsibilities of the banking sector. Pravakar Sahoo and Bibhu Prasad Nayak (*Indian Economic Journal*)- "Green Banking"- say an effort by the banks to make the industries grow green and in the process restore the natural environment. This concept of "Green Banking" would be mutually

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beneficial to the banks, industries and the economy. Green banking will also ensure the greening of the industries but it will also facilitate in improving the asset quality of the banks in future.

The development of extensive rules for environmental management like resource conservation, clean water act, clean air act, toxic substance control act are also viewed as potentially significant contributor to the recent increase in environmental liability for banking institutions. Adoption of the above principles would offer significant benefits to financial institutions, to consumers and also the stakeholders.

There have been attempts to adopt sustainable development strategies from various quarters at international level. Multilateral agencies, international consortium, multilateral financial and development institutions have been advocating for environmental standards and strategies to evaluate investment projects. In the recent years, the international organization for standardization (ISO) has issued series of comprehensive guidelines for incorporating environmental protection and pollution prevention objectives into industrial activity worldwide, known collectively as ISO 14000. It will certainly give the much needed impetus for the banking industry to expand the use of environmental information in their credit extension and investment decisions.

The banking operation targets a certain long-term rate of return on their credit and investment. Nevertheless, every credit extension and investment carry the risk of non-payment and reduction of value (in case of direct investment) due to environmental liabilities. Therefore, it is of importance to the banking sector to follow certain environmental evaluation of the projects before financing. There are studies showing positive correlation between environmental performance and financial performance (Hamilton, 1995; Hart, 1995; Blacconiere and Pattern, 1993). Thus, it is essential for the financial institutions in the present to consider environmental performance in deciding whether to invest in companies or advise the clients in doing so.

Objectives of the study

1. To study concept of 'Green Bank'
2. To identify the steps necessary to adopt green banking
3. To check the awareness of green banking among bank employees, associates and general public.
4. To create awareness about green banking among the general public and consumers and bank employees.

Green banking

What is green banking?

"Green Banking" itself insinuates promoting environmental-friendly banking practices and reducing carbon footprint

from banking activities. To add simplicity to this term, it is a form of banking which ensures less utilization of natural resources and optimal reduction of wastage of paper/ carbon footprint.

Green banking is being practiced by all banks, which consider all the social and environmental/ecological factors with an aim to protect the environment and conserve natural resources. Green banking practices are also labeled as "ethical banking" or a sustainable banking. The key idea behind this banking concept is to enhance the conservation of earth's environment/habitats/resources.

How can it be done?

1. Promoting the usage of online banking instead of branch banking.
2. Paying bills online.
3. Opening up CDs and money market accounts through online banking, instead of large multi-branch banks.

Why is green banking important?

Until recently, green banking just seemed like an initiative and such environmental concerns did not really seem to be relevant to a bank's operations. Initially, a bank checking their client's environmental worthiness would have been considered as prying into a private business. However, now the perception looks towards how this brings risks to their business. Although the banking and financial institutions are not directly affected by the environmental degradation, there are indirect costs to banks.

Credit, legal and reputation risks have constantly been haunting these banks unless such initiatives are taken.

Steps in green banking

Go online

Online banking is the thriving concept in young and corporate India. Online banking helps in additional conservation of energy and natural resources. Online banking includes:

- a. Paying bills online,
- b. Remote deposit,
- c. online fund transfers

It helps in savings paper, energy, and expenditure of natural resources due to banking activities. Customers can save money by avoiding late payments of fees and save time by avoiding standing into queues and paying the bill.

Use green checking accounts

Customers can check their account details through ATM

machines provided in bank kiosks or special touch screens in the branches of different banks. This can be called green checking of account. Often usage of online banking services like online bill payment, using debit cards for payments against payments, and online statements help the environment against detritions. Banks should promote green checking by giving some incentives to customers by giving higher rate of interests, waiver or discount in fees etc.

Use green loans for home improvements

The Ministry of Non-renewable Resource in association with some nationalized and scheduled commercial banks in India undertook an initiative to go green by allowing low interest loans to the customers who would like to buy solar equipment; the rate of interest is as low as 4% p.a. The new Green Home Loan Scheme from SBI, for instance, supports environmental friendly residential projects and offers various concessions. These loans are sanctioned for projects rated by the Indian Green Building Council (IGBC) and offer several financial benefits –5 percent concessions in margin, 0.25 percent concession in interest rate and processing fee waiver.

Power savings equipment

Banks directly contribute to controlling climate change and as an initial step they intend to start a campaign to replace all fused GSL bulbs, in all owned premises offices and residential. Banks have also initiated a feasibility study to make rain water harvesting mandatory in all the Bank's owned premises. In December 2009 IndusInd Bank inaugurated Mumbai's first solar-powered ATM as part of its 'Green Office Project' campaign titled 'Hum aurHariyali'.

Use green credit cards

Banks are promoting different schemes of using plastic money rather than currency notes in order to save environment.

Use of solar and wind energy

Using solar and wind energy is one of the noble causes for going green. State Bank of India (SBI) has become the first bank in the country to venture into generation of green power by installing windmills for captive use. As part of its green banking initiative, SBI has installed 10 windmills with an aggregate capacity of 15 MW in the states of Tamil Nadu, Maharashtra and Gujarat.

Mobile banking

Mobile banking saves time and energy of the customers.

It also helps in reducing use of energy and paper of the bank. Most of the Indian banks have introduced this paper-less facility in order to be eco-friendly.

How can the customers help?

Converting to an online savings account and mobile banking is the easiest way to go green and help the environment. Green banking includes setting up direct deposit to receive your paychecks, receiving electronic statements from banks and by paying bills online. All of these steps can drastically reduce the amount of paper used by bank.

Online banking and mobile banking are also highly effective ways to keep track of financial transactions and to avoid late payment fees.

Many banks claim to be eco-friendly, but in fact do little to support environment initiatives with the money you deposit with them.

1. Enquire the local bank exactly how they support the environment before assuming their self-anointed "Green Bank" label is appropriate. Chances are good that there is a single bank in the local market that is significantly more socially-conscious of their policies than their competitors.
2. Finally, the more people who actively search for and support eco-friendly banks, the more competition for deposits will increase and thus raise the awareness for green banking.

GREEN BANKING IN INDIA

With the solar-powered ATM, the banks are expecting to save around 1,980 Kw of energy annually besides reducing carbon emissions by 1,942 kg. It also expects to save power bills of around Rs. 20,000 per year in urban areas, where it replaces diesel generators with solar panels.

In a bid to reduce the carbon footprint, RomeshSobti, MD and CEO of IndusInd Bank, who describes "green banking" as his mission, has also introduced thin computing (which reduces the need for many personal computers), e-archiving, e-learning, e-waste management, paperless fax, energy conservation, CNG cars and supporting finance programs with incentives to go green.

IndusInd Bank is just one of the several leading Indian banks with similar plans. "There is already a group of leading banks in India that recognize the importance of their role and the commercial advantage this will give them," says Emily Farnworth, senior advisor on the finance sector to the Climate Group, which acts as secretariat to signatories of the Climate Principles.

For instance, the State Bank of India (SBI), as part of its green banking policy, plans to set up captive windmills

to generate 15 Mw of power in Tamil Nadu, Maharashtra and Gujarat.

A new study by PricewaterhouseCoopers (PwC) commissioned by the Indian Banks' Association (IBA) and the Climate Group confirms that India's leading banks are recognizing and seizing opportunities in an emerging low-carbon economy.

According to Farnworth, "Seven out of the eight banks in the survey believe commercial lending banks in India can play a leadership role in the business community in addressing the challenges of climate change; they are starting to invest in low-carbon technologies and develop new products and services that will address the risks and opportunities of climate change".

For instance, in coal technologies, ICICI Bank introduced innovative concepts like deep beneficiation of coal (coal washeries) and coal bed methane. It also assisted a company develop a product that provides an eco-friendly air-conditioning alternative to conventional air conditioners (ACs).

ICICI Bank also initiated a program to sensitize corporate bodies, institutions, banks and government agencies involved in project planning on issues like biodiversity, wildlife habitats and environmental laws.

Energy efficiency is another key focus of banks, with an estimated market worth more than \$15 billion by 2015 in India. IDBI Bank, for instance, has an exclusive team working on clean development mechanism (CDM) advisory services. It also implemented a refinance scheme for energy saving projects for micro, small and medium enterprises sector.

Yes bank, too, is incorporating community development initiatives such as clean and green drives, energy efficiency practices, workplace health and safety and the development of local disaster management plans through its "Yes Community" initiatives.

Green banking financial products

Indian banks should develop innovative green banking financial products which can directly or indirectly help in the reduction of carbon emissions. These banks can introduce a 'Green Fund' to provide climate conscious customers- the option of investing in environmental friendly projects. Banks can also introduce green bank loans with financial concessions for environmental friendly products and projects.

Green mortgages

There are two types of green mortgages: the Energy Improvement Mortgage – it is like a second mortgage that is used to upgrade a home or building to energy efficient by installing energy saving items such as solar panels and improved insulation - and the Energy Efficient Mortgages used for the construction of new energy

efficient homes and buildings.

There are many states getting in on the green mortgage by offering subsidized green mortgages so that more home-owners and business owners can "green-up" their buildings. In addition to help save the environment by using less energy, these mortgages offer many advantages to consumers by reducing the money spent on high utility bills and on high costs of obtaining a mortgage. The Residential Energy Services Network reported on a recent study showing that the market value of a home increases \$20 for every \$1 decrease in energy costs.

GREEN BANKING AND HOW SBI IMPLEMENTED IT

State Bank of India (SBI) has richly merited its status as the flagship of Indian banking. In several fields, the bank has pioneered innovative process and adds significantly to the escalation of the Indian economy, while recuperating its own unbroken record of profitability over the years. It is the market leader in Educational Loans, Auto Loans and the No. 1 home loan. Bank has vast domestic network. It has numerous rewards and recognitions in various banking and Corporate Social Responsibility (CSR) initiatives to its credit. Prominent CSR activities being distribution of lakhs of electric fans and ongoing distribution of water filters in schools in India, financing Save The Girl Child projects, and promoting 'Green Banking' by changing traditional paper banking to card based banking and installation of Windmills. The bank has also been an active participant in wildlife conservation projects like 'Save the Tiger'.

The green channel counter

The bank had launched 'Green Channel Counter'(GCC) facility on State Bank Day 01.07.2010), at 57 select branches of the bank spread across the country. This was an innovative step taken by the bank towards changing the traditional way of paper based banking in a limited way, to card based 'Green Banking' focusing on reduction in paper usage as well as saving transaction time. This is a pioneering concept which would save both paper and time resources.

At the dawn of State Bank Day 2011 (01.07.2011), and on the First Anniversary of the launch of GCC, this facility has been made available at 5000+ branches across the country. During this journey of one year the Green Channel Counter facility has earned many accolades. At the IBA Banking Technology Awards – 2010, SBI won the "Best Customer Initiative" Award for the Green Channel Counter. In addition, this has led to the saving of enough papers to avoid felling of approximately '5 Trees'.

As such, the GCC aims at providing our customers with a simple, secure and quick way of executing daily banking transactions. It enhances customer ease as there is no need to remember the 11 digit account

number or carry passbook, fill in pay in slips / withdrawal forms, etc. Only the ATM cum Debit Card and PIN is needed to identify a Customer and his / her bank account.

It is a counter manned by a Teller where a Transaction Processing Device (TPD), similar to a Pass book printing machine, is attached to the terminal. Customer swipes the Shopping cum Debit Card, selects a particular transaction and enters the amount and the PIN. Post authentication, the transaction gets transferred to the Teller's terminal that enters denominations of cash to be paid / received, then pays / receives cash and completes the transaction. The customer is provided with a printed receipt generated from TPD. This receipt is much smaller than traditional voucher. Moreover, as only one receipt is printed per transaction, there is zero paper wastage.

Three types of transactions have been enabled through this facility viz Cash Deposits, Cash Withdrawals and Funds Transfer. The transaction amount has been fixed as Rs 40,000/-.

Customers can use the Green Channel Counter without queues and without taking the token. They may simply walk up to the Counter, Swipe their card and execute the transaction. Also it has been observed that while normal branch banking transactions take 2 to 4 min for completion, a transaction routed through the GCC takes less than a minute. Thus the Green Channel Counter is not only an endeavor to offer ease of transactions to all customers especially senior citizens, but also an environment friendly initiative.

Wind mills

State Bank of India (SBI) has become the first bank in the country to venture into production of green power by installing windmills for captive use. As part of its green banking initiative, SBI has installed 10 windmills with an aggregate capacity of 15 MW in the states of Tamil Nadu, Maharashtra and Gujarat. SBI has planned to install an additional 20 MW capacity of windmills in Gujarat soon and aims to touch 100 MW power generations through windmills within five years. The total cost of installation of a windmill of 1.5 MW is around Rs. 10 crore. The operation cost is close to zero. The bank is also supporting the green initiatives of its clients and is offering them finance on priority and at concessionary rates of interest. The bank has launched a loan product called 'Carbon Credit Plus' to finance the future CER receivables of CDM projects.

SBI goes "GREEN" with home loans

1. Green Housing Loan is for customers who are buying properties in green projects which reduce carbon emissions and promote renewable energy.

2. Special feature: 5% discount on the margin money, 0.25% concession on interest rate and waiver of processing fees for customers going in for the green projects.

3. Maximum term – 25 years (up to a maximum age of 70)

4. Quantum of loan – Minimum loan amount of Rs 5 lakh

5. Rate of Interest- The bank provides the loans in two categories fixed and floating. For loans above 75 Lakh the interest rate will be only floating rate based on SBAR.

6. Documentation – Salaried individuals need to show income related documents along with 6 months bank statement, for self - employed and business persons; the documentation includes last 3 years income tax returns and profit and loss statement of the business activity. The customer has to also provide signature identification from current banker.

7. Fees: The bank charges a fixed fees based on the quantum of loan. Rs 1000 for loans below 5 lakh, Rs 2000 for 5-10 Lakh, Rs 5000 for 10-20 lakh, Rs 7000 for 20-50 lakh

By launching 'Green Homes', the country's largest bank wants to support rated environment friendly residential projects by offering concessions - reduced margin, softer interest rate, and zero processing fee - on home loans to discerning buyers.

A 'Green Building/ Home', according to the IGBC, is one that uses less energy, water and natural resources, creates less waste and is healthier for the people living inside compared to a standard building. The council is a part of the Confederation of Indian Industry - Sohrabji Godrej Green Business Centre (Table 1).

HOW THE OTHER BANKS IMPLEMENTED IT

Punjab National Bank and its green streak

Green initiatives taken by the bank includes promotion of rain water harvesting, reduction in usage of paper by using e-mail for inter-office communications, reduced power consumption through various energy conservation measures and conducting tree plantation drives. The bank also promotes the green initiative in the following ways:

1. Conducting electricity audit of offices as an energy conservation initiative.

2. Emphasizing on green buildings

3. Adopting simple green practices such as energy efficient lights, printing on both sides of paper, purchasing composite fax machines, immediate repair of water leakage etc.

4. In 2010-2011 Bank sanctioned a wind energy projects with aggregate limit of Rs.185.81 crore.

5. Guideline for providing finance to units producing clean

Table 1. SBI goes "GREEN" with home loans.

	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10
Income					
Interest earned	136,350.80	119,657.10	106,521.45	81,394.36	70,993.92
Other income	18,552.92	16,034.84	14,351.45	14,930.42	14,968.15
Total income	154,903.72	135,691.94	120,872.90	96,324.78	85,962.07
Expenditure					
Interest expended	87,068.63	75,325.80	63,230.37	48,867.96	47,322.48
Employee cost	22,504.28	18,380.90	16,974.04	15,211.62	12,754.65
Selling and admin expenses	0	0	0	0	7,898.23
Depreciation	1,333.94	1,139.61	1,007.17	990.5	932.66
Miscellaneous expenses	33,105.70	26,740.65	27,954.03	23,884.37	7,888.00
Preoperative ExpCapitalised	0	0	0	0	0
Operating expenses	35,725.85	29,284.42	26,068.99	23,015.44	24,941.01
Provisions and contingencies	21,218.07	16,976.74	19,866.25	17,071.05	4,532.53
Total expenses	144,012.55	121,586.96	109,165.61	88,954.45	76,796.02
Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	
Net profit for the year	10,891.17	14,104.98	11,707.29	7,370.35	9,166.05
Extra-ordinary items	0	0	0	0	0
Profit brought forward	0.34	0.34	6.05	0.34	0.34
Total	10,891.51	14,105.32	11,713.34	7,370.69	9,166.39
Preference dividend	0	0	0	0	0
Equity dividend	2,239.71	2,838.74	2,348.66	1,905.00	1,904.65
Corporate dividend tax	298.45	375.95	296.49	246.52	236.76
Per share data (annualized)					
Earnings per share (Rs)	145.88	206.2	174.46	116.07	144.37
Equity dividend (%)	300	415	350	300	300
Book value (Rs)	1,584.34	1,445.60	1,251.05	1,023.40	1,038.76
Appropriations					
Transfer to statutory reserves	8,353.03	10,890.29	9,067.85	5,218.83	6,495.14
Transfer to other reserves	0	0	0	0	529.5
Proposed dividend/transfer to Govt	2,538.16	3,214.69	2,645.15	2,151.52	2,141.41
Balance c/f to balance sheet	0.32	0.34	0.34	0.34	0.34
Total	10,891.51	14,105.32	11,713.34	7,370.69	9,166.39

energy such as solar energy, wind energy and hydel energy on merits of each case which helps in containing Green House Gases emission leading to clean environment.

Performance and sustainability of the bank

The bank has made a net profit of Rs.4747.67 Crores in 2013. While PNB has been consolidating its asset book quite well in the last couple of quarters and they have started picking up in the last quarter itself. Q3 2013 had been pretty good for them but in Q4 they surprised us

negatively as far as fresh slippages are concerned PNB had surprised us a little more negatively than what was estimated. The bank's profit and loss statement comparative study is in Table 2.

Bank of Baroda

According to the annual report of BOB (2013), they had taken various green banking initiatives such as: -

1. While financing a commercial project, BOB is giving preference to environmentally friendly green projects

Table 2. Profit and loss account of Punjab National Bank

	Mar'14	Mar '13	Mar '12	Mar '11	Mar'10
	12 mths	12 mths	12 mths	12 mths	12 mths
Income					
Interest earned	43,223.25	41,893.33	36,428.03	26,986.48	21,466.91
Other income	4,576.71	4,215.92	4,202.60	3,612.58	3,565.31
Total income	47,799.96	46,109.25	40,630.63	30,599.06	25,032.22
Expenditure					
Interest expended	27,077.28	27,036.82	23,013.59	15,179.14	12,944.02
Employee cost	6,510.45	5,674.72	4,723.48	4,461.10	3,121.14
Selling and admin expenses	0.00	0.00	0.00	0.00	1,701.46
Depreciation	352.39	318.50	292.26	255.85	222.83
Miscellaneous expenses	10,517.26	8,331.53	7,717.10	6,269.47	3,137.42
Preoperative ExpCapitalised	0.00	0.00	0.00	0.00	0.00
Operating expenses	9,338.21	8,165.05	7,002.75	6,364.22	5,761.36
Provisions and contingencies	8,041.89	6,159.70	5,730.09	4,622.20	2,421.49
Total expenses	44,457.38	41,361.57	35,746.43	26,165.56	21,126.87
Net profit for the year	3,342.58	4,747.67	4,884.20	4,433.50	3,905.36
Extra ordinary items	0.00	0.00	0.00	0.00	0.00
Profit brought forward	0.00	0.00	0.00	0.00	7.64
Total	3,342.58	4,747.67	4,884.20	4,433.50	3,913.00
Preference dividend	0.00	0.00	0.00	0.00	0.00
Equity dividend	362.07	954.38	746.19	696.99	693.67
Corporate dividend tax	58.66	162.20	121.05	113.07	116.43
Per share data (annualized)					
Earnings per share (Rs)	92.32	134.31	144.00	139.94	123.86
Equity dividend (%)	100.00	270.00	220.00	220.00	220.00
Book value (Rs)	991.39	924.45	820.13	678.91	514.77
Appropriations					
Transfer to statutory reserves	2,921.85	3,631.10	4,016.96	3,623.44	1,532.46
Transfer to other reserves	0	-0.01	0	0	1,570.44
Proposed dividend/transfer to Govt	420.73	1,116.58	867.24	810.06	810.1
Balance c/f to balance sheet	0	0	0	0	0
Total	3,342.58	4,747.67	4,884.20	4,433.50	3,913.00

such as windmills, biomass and solar power projects which help in earning the carbon credits.

2. The organization had made considerable changes in their lending policy, i.e. it is compulsory for industries to obtain 'No Objection Certificate' from the Pollution Control Board and also they are not extending any finance to environmental hazardous industries which are using ozone depletion substances such as halos-1211, 1301, 2402 used in foam products, chlorofluoro carbon CFC 11, 12,113, solvents in cleaning and aerosol products.

3. The bank had taken several technological initiatives such as compliance with e-business guidelines, use of

internet banking, mobile banking to promote paperless banking and also increasing the installation of ATM's in most of uncovered areas to reduce the petrol or diesel consumption in travelling and helps in maintaining a clean environment.

4. As a part of green initiative, they had made changes to desktop virtualization; backup consolidation and server virtualization improve data center operational efficiency.

Performance and sustainability of the bank

The kind of numbers that BoB has delivered in the recent

Table 3. Profit and loss account of Bank of Baroda.

	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10
	12 mths	12 mths	12 mths	12 mths	12 mths
Income					
Interest earned	38,939.71	35,196.65	29,673.72	21,885.92	16,698.34
Other income	4,462.74	3,630.62	3,422.33	2,809.19	2,806.36
Total income	43,402.45	38,827.27	33,096.05	24,695.11	19,504.70
Expenditure					
Interest expended	26,974.36	23,881.39	19,356.71	13,083.66	10,758.86
Employee cost	4,139.72	3,449.65	2,985.58	2,916.78	2,350.88
Selling and admin expenses	0	0	0	0	1,627.56
Depreciation	345.03	300.64	276.57	243.04	230.86
Miscellaneous expenses	7,402.26	6,714.88	5,470.24	4,209.94	1,478.21
Preoperative ExpCapitalised	0	0	0	0	0
Operating expenses	7,137.07	5,946.74	5,158.72	4,629.83	4,711.23
Provisions and contingencies	4,749.94	4,518.43	3,573.67	2,739.93	976.28
Total expenses	38,861.37	34,346.56	28,089.10	20,453.42	16,446.37
Net profit for the year					
Extraordinary items	0	0	0	0	0
Profit brought forward	0	0	0	0	0
Total	4,541.08	4,480.72	5,006.96	4,241.68	3,058.33
Preference dividend	0	0	0	0	0
Equity dividend	923.24	905.74	694.32	646.05	548.29
Corporate dividend tax	160.43	153.89	117.97	107.3	0
Per share data (annualized)					
Earnings per share (Rs)	105.75	106.37	121.79	108.33	83.96
Equity dividend (%)	215	215	170	165	150
Book value (Rs)	838.02	758.91	668.34	537.45	414.71
Appropriations					
Transfer to statutory reserves	2,056.03	2,051.63	1,740.81	1,387.87	1,162.07
Transfer to other reserves	1,401.38	1,369.46	2,453.86	2,100.46	1,257.00
Proposed Dividend/transfer to Govt	1,083.67	1,059.63	812.29	753.35	548.29
Balance c/f to balance sheet	0	0	0	0	90.97
Total	4,541.08	4,480.72	5,006.96	4,241.68	3,058.33

years has been appreciated throughout. On the margin front bank had some dip and net interest income (NII) was also little lower than estimated, but the other operating income was significant during the year. The profit and loss comparative is in Table 3 and Figure 1.

ICICI Bank

1. ICICI Bank is offering 50% concession on processing fee on car models to those customers who use more environmental friendly vehicle.
2. If customer purchases home in Leadership in Energy and Environmental Design then they have to pay reduced processing fee under ICICI Home Finance.

3. ICICI Bank is working on and looking forward to partnership with National & International Green organization & NGOs.

4. Communication on Online bill pay, Online funds transfer and subscribing to e – statements in order to migrate the customers to “paperless and commute free banking”.

Performance and analysis

ICICI Bank it is expected to cross Rs 1625 crore in profit making. Analysts give thumbs-up to ICICI Bank post Q3 earnings. The comparative table showing the rise in profit is in Table 4.

Table 4. Profit and loss account of ICICI Bank.

	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10
	12 mths	12 mths	12 mths	12 mths	12 mths
Income					
Interest Earned	44,178.15	40,075.60	33,542.65	25,974.05	25,706.93
Other Income	10,427.87	8,345.70	7,502.76	6,647.89	7,292.43
Total Income	54,606.02	48,421.30	41,045.41	32,621.94	32,999.36
Expenditure					
Interest expended	27,702.59	26,209.18	22,808.50	16,957.15	17,592.57
Employee Cost	4,220.11	3,893.29	3,515.28	2,816.93	1,925.79
Selling and Admin Expenses	0	0	0	0	6,056.48
Depreciation	575.97	490.16	42.26	483.52	619.5
Miscellaneous Expenses	12,296.88	9,503.20	8,214.12	7,212.96	2,780.03
Preoperative ExpCapitalised	0	0	0	0	0
Operating Expenses	10,308.86	9,012.89	7,850.44	6,617.24	10,221.99
Provisions & Contingencies	6,784.10	4,873.76	3,921.22	3,896.17	1,159.81
Total Expenses	44,795.55	40,095.83	34,580.16	27,470.56	28,974.37
Net Profit for the Year					
Extraordinary Items	0	0	0	0	-0.09
Profit brought forward	9,902.29	7,054.23	5,018.18	3,464.38	2,809.65
Total	19,712.77	15,379.70	11,483.44	8,615.76	6,834.54
Preference Dividend	0	0	0	0	0
Equity Dividend	2,656.28	2,307.23	1,902.04	1,612.58	1,337.86
Corporate Dividend Tax	231.25	292.16	220.35	202.28	164.04
Per share data (annualized)					
Earning Per Share (Rs)	84.95	72.22	56.09	44.73	36.1
Equity Dividend (%)	230	200	165	140	120
Book Value (Rs)	633.92	578.65	524.01	478.31	463.01
Appropriations					
Transfer to Statutory Reserves	3,506.65	2,878.03	2,306.49	1,782.45	1,867.22
Transfer to Other Reserves	0	0	0.33	0.26	1.04
Proposed Dividend/Transfer to Govt	2,887.53	2,599.39	2,122.39	1,814.86	1,501.90
Balance c/f to Balance Sheet	13,318.59	9,902.29	7,054.23	5,018.18	3,464.38
Total	19,712.77	15,379.71	11,483.44	8,615.75	6,834.54

Standard Chartered Bank

Standard Chartered Bank always try to minimize their direct impact on the environment and set stringent targets for reducing consumption of energy, air travel, water and paper (Figure 2). Their green banking initiatives include:

1. Use of LED signboards.
2. Construction of green terraces in office buildings.
3. "Green Zone" paper recycling initiative to recycle 100 tons of paper annually.
4. Water conservation efforts like the waterless urinals & auto closure taps.

5. Use of Wind energy that reduces Carbon footprint by 134tons/year and a 12% reduction in power cost.

6. Launching an innovative new program Statement for life- that helps redirect paper saving to donate books to the girls enrolled in their Goal programme, when customers sign up for E – Statements.

Yes Bank

Yes Bank is a first Indian signatory to the carbon disclosure project and has documented its carbon footprint. It is also the first Indian Bank from the Private

Profit Before Tax & Profit After Tax

PBT stands for Profit Before Tax, and PAT stands for Profit After Tax.

The graph visually shows how the net profit of the company stand reduced due to the impact of Tax.

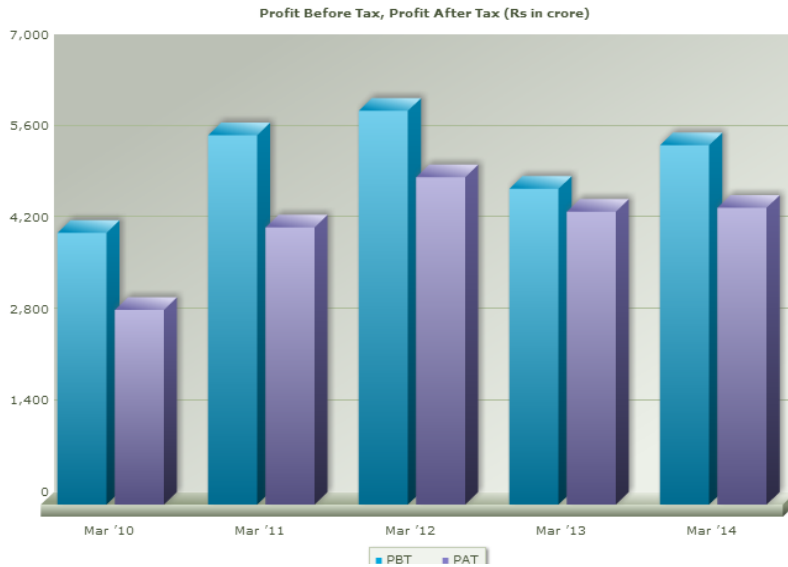


Figure 1. Profit and Loss account of Bank of Baroda.

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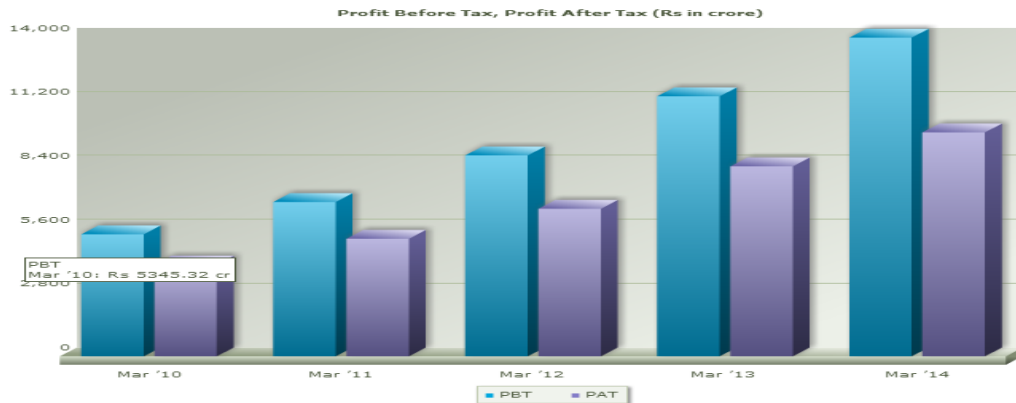


Figure 2. Profit and loss account of ICICI Bank.

sector to become signatory to UNEP statements by financial institutions on the environment and sustainable development. Yes Bank also advocated a proactive response to climate change from its peers in the banking community, industries and society as well. SIB is the

Bank’s specialized Investment Advisory for Sustainable Ventures commanding expertise in the areas of:

1. Alternate Energy and Environment Advisory
2. Social Enterprises and Rural Advisory

Table 5. Profit and loss account of Yes Bank

	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10
	12 mths	12 mths	12 mths	12 mths	12 mths
Income					
Interest Earned	9,981.35	8,294.00	6,307.36	4,041.75	2,369.71
Other Income	1,721.58	1,257.43	857.12	623.27	575.53
Total Income	11,702.93	9,551.43	7,164.48	4,665.02	2,945.24
Expenditure					
Interest expended	7,265.09	6,075.21	4,691.72	2,794.82	1,581.76
Employee Cost	784.4	655.54	475.15	362.34	256.89
Selling and Admin Expenses	0	0	203.03	185.25	182.76
Depreciation	63.17	51.71	40.82	34.84	30.26
Miscellaneous expenses	1,972.49	1,468.29	776.76	560.64	415.84
Preoperative ExpCapitalized	0	0	0	0	0
Operating Expenses	1,749.87	1,334.53	944.1	719.08	587.76
Provisions and contingencies	1,070.19	841.01	551.66	423.99	297.99
Total expenses	10,085.15	8,250.75	6,187.48	3,937.89	2,467.51
Net Profit for the Year					
Extra ordinary Items	0	0	0.04	-0.04	0
Profit brought forward	2,338.37	1,658.39	1,115.06	672.95	405.78
Total	3,956.15	2,959.07	2,092.10	1,400.05	883.52
Preference Dividend	0	0	0	0	0
Equity Dividend	288.51	215.17	141.2	86.79	50.95
Corporate Dividend Tax	49.03	34.91	22.91	14.41	8.66
Per share data (annualized)					
Earning per share (Rs)	44.86	36.27	27.68	20.95	14.06
Equity Dividend (%)	80	60	40	25	15
Book Value (Rs)	197.48	161.94	132.49	109.29	90.96
Appropriations					
Transfer to Statutory Reserves	411.15	370.63	269.61	183.79	150.95
Transfer to Other Reserves	0	0	-0.01	0	0
Proposed Dividend/Transfer to Govt	337.54	250.08	164.11	101.2	59.61
Balance c/f to Balance Sheet	3,207.46	2,338.37	1,658.39	1,115.06	672.95
Total	3,956.15	2,959.08	2,092.10	1,400.05	883.51

The team is one of the few specialized Investment Banking divisions actively involved in supporting initiatives on Renewable Energy, Clean Technology and Socially Sustainable Sectors (broadly defined as Healthcare, Education, Livelihood Creation, Water and Sanitation, etc.).

Performance and analysis

Though Yes Bank has provided some outstanding initiatives, the net profit for the year 2013 has been calculated to 1617.78 cr. The performance of the bank has been

relatively low. Its profit and loss comparative study is in Table 5 and Figure 3.

IDBI Bank

IDBI Bank took a step towards green initiative in corporate governance in which the bank send all the documents relating to General meeting notices/other notices, Annual report etc. to their shareholders in electronic form. IDBI Bank has an exclusive team working on Clean Development Mechanism (CDM) advisory services. It also implemented a refinance scheme for energy saving

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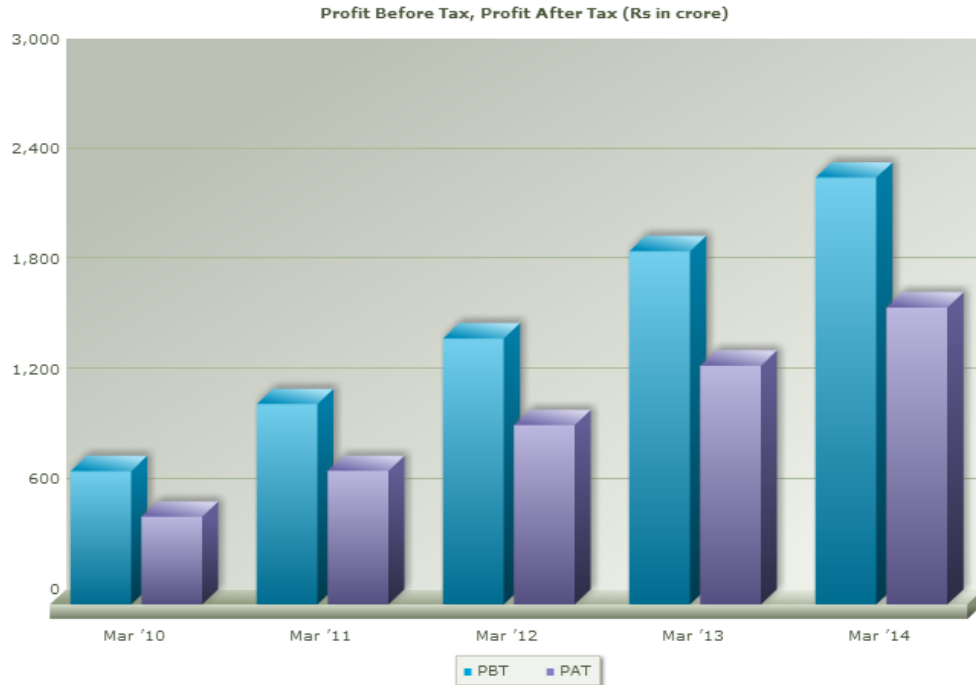


Figure 3. Profit and loss account of Yes Bank.

projects for Micro, Small and Medium Enterprises.

Performance and analysis

Public sector lender IDBI Bank's third quarter net profit dropped 75 percent to Rs 104 crore compared to same quarter last year, dented by a steep fall in non-interest income and slow growth in net interest income. Net interest income, the difference between interest earned and interest expended, grew from 5.3 percent to Rs 1,488.4 crore during October-December period. Other income or non-interest income fell from 39 percent year-on-year to Rs 532 crore in the quarter gone by (Table 6 and Figure 4).

Central Bank of India

Central Bank of India launched "Go Green" Campaign for its customers with a purpose to promote Green Banking which is Paperless and Queue less Banking and also

promotes use of recyclable products for banks stationery using TYVEK materials. In this, customers are motivated to opt for E statements, use internet banking and use E-Voucher machine for transactions.

Performance and analysis of Central Bank of India

The operating profit of the Bank increased to 3173 crore from 2815 crore in 2011-12 registering a growth of 12.72% Y-o-Y whereas the Net profit of the Bank increased to 1015 crore from 533 crore in 2011-12 registering a marvelous growth of 90.43% (Table 7 and Figure 5).

Axis Bank Ltd

AXIS bank implemented several initiatives in green banking such as:-

1. In August 2011, the bank had initiated the process of

Table 6. Profit and loss account of IDBI Bank.

	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10
	12 mths	12 mths	12 mths	12 mths	12 mths
Income					
Interest Earned	26,597.51	25,064.30	23,369.93	18,600.82	15,272.63
Other Income	2,978.75	3,219.51	2,009.54	2,103.56	2,341.96
Total Income	29,576.26	28,283.81	25,379.47	20,704.38	17,614.59
Expenditure					
Interest expended	20,576.04	19,691.19	18,825.08	14,271.93	13,005.22
Employee Cost	1,491.61	1,538.50	1,160.44	1,026.50	756.99
Selling and Admin Expenses	0	0	1,598.62	1,830.00	720.9
Depreciation	113.17	124.12	116.06	127.04	90.98
Miscellaneous expenses	6,274.05	5,047.92	1,784.92	1,798.60	2,009.37
Preoperative ExpCapitalised	0	0	0	0	0
Operating Expenses	3,318.84	3,134.37	3,567.82	3,509.84	2,067.76
Provisions and Contingencies	4,559.99	3,576.17	1,092.22	1,272.30	1,510.48
Total Expenses	28,454.87	26,401.73	23,485.12	19,054.07	16,583.46
Net profit for the year	1,121.40	1,882.08	1,894.34	1,650.32	1,031.13
Extraordinary Items	0	0	137.25	0	0
Profit brought forward	903.86	672.65	615.02	470.4	71.2
Total	2,025.26	2,554.73	2,646.61	2,120.72	1,102.33
Preference Dividend	0	0	0	0	0
Equity Dividend	160.41	466.47	388.68	344.6	217.46
Corporate Dividend Tax	27.77	71.75	60.33	55.27	31.47
Per share data (annualized)					
Earnings Per Share (Rs)	6.99	14.12	14.82	16.76	14.23
Equity Dividend (%)	10	35	35	35	30
Book Value (Rs)	147.38	159.33	137.47	128.69	113.5
Appropriations					
Transfer to Statutory Reserves	540.32	962.65	774.95	514.55	283
Transfer to Other Reserves	399.99	150	750.01	600	100
Proposed Dividend/Transfer to Govt	188.18	538.22	449.01	399.87	248.93
Balance c/f to Balance Sheet	896.77	903.86	672.65	606.3	470.4
Total	2,025.26	2,554.73	2,646.62	2,120.72	1,102.33

collecting all the dry waste generated from the corporate office and thirty four branch offices in Mumbai, and recycles it to notepads, notebooks and envelopes.

2. Till date, more than 1,00,000 kg of paper has been recycled and converted to 12,000 notebooks, notepads and envelopes which are used at corporate office and branches of the bank;

3. The corporate office of the bank, located in Mumbai, is designed and constructed as a Platinum LEED certified 'Green Building';

4. Carpooling has been initiated by a bank to reduce carbon footprint;

5. They are also encouraging their customers to use e-

Statements and other electronic communications to reduce paper consumption;

6. Annual reports are being sent through emails;

7. The organization had initiated Independent ATM Deployment (IAD) model in which ten solar based ,ATM has been set up in Coimbatore circle

Performance and analysis

The net profit has been calculated as Rs 6217.67 cr and it has a whopping 20.05% growth rate from the previous year. The Bank has continued to focus on the quality of

Profit Before Tax & Profit After Tax

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The graph visually shows how the net profit of the company stand reduced due to the impact of Tax.



Figure 4. Profit and loss account of IDBI Bank.

Table 7. Profit and loss account of Central Bank of India

	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10
	12 mths	12 mths	12 mths	12 mths	12 mths
Income					
Interest Earned	24,427.55	21,860.65	19,149.50	15,220.57	12,064.31
Other Income	1,922.58	1,667.33	1,395.30	1,265.04	1,735.25
Total Income	26,350.13	23,527.98	20,544.80	16,485.61	13,799.56
Expenditure					
Interest expended	17,933.16	16,123.08	13,980.86	9,895.23	9,519.01
Employee Cost	3,537.01	2,891.55	2,506.24	2,964.22	1,544.19
Selling and Admin Expenses	0	0	1,973.46	1,199.89	664.7
Depreciation	208.55	184.45	143.54	118.69	78.75
Miscellaneous Expenses	5,934.25	3,313.94	1,407.67	1,055.17	934.67
Preoperative ExpCapitalised	0	0	0	0	0
Operating Expenses	5,178.94	4,232.33	5,123.99	4,630.78	2,510.42
Provisions and contingencies	4,500.87	2,157.61	906.92	707.19	711.89
Total expenses	27,612.97	22,513.02	20,011.77	15,233.20	12,741.32
Net Profit for the Year	-1,262.84	1,014.96	533.04	1,252.41	1,058.23
Extraordinary Items	0	0	0	0	0
Profit brought forward	1.58	1.48	1.48	1.13	1.13
Total	-1,261.26	1,016.44	534.52	1,253.54	1,059.36
Preference Dividend	0	150.5	128.59	114.87	53.09
Equity Dividend	0	261.14	147.22	137.41	88.91
Corporate Dividend Tax	0	69.49	44.45	41.09	24.13
Per share data (annualized)					
Earning Per Share (Rs)	-9.35	8.28	5.49	28.15	24.87
Equity Dividend (%)	0	25	20	25	22
Book Value (Rs)	104.94	131.11	121.42	131.2	107.96

Table 7. Contd.

Appropriations					
Transfer to Statutory Reserves	42.54	333.73	192.21	430.97	326.18
Transfer to Other Reserves	-1,303.80	200	20.57	527.72	565.92
Proposed Dividend/Transfer to Govt	0	481.13	320.26	293.37	166.13
Balance c/f to Balance Sheet	-1,303.80	1.58	1.48	1.48	1.13
Total	-2,565.06	1,016.44	534.52	1,253.54	1,059.36

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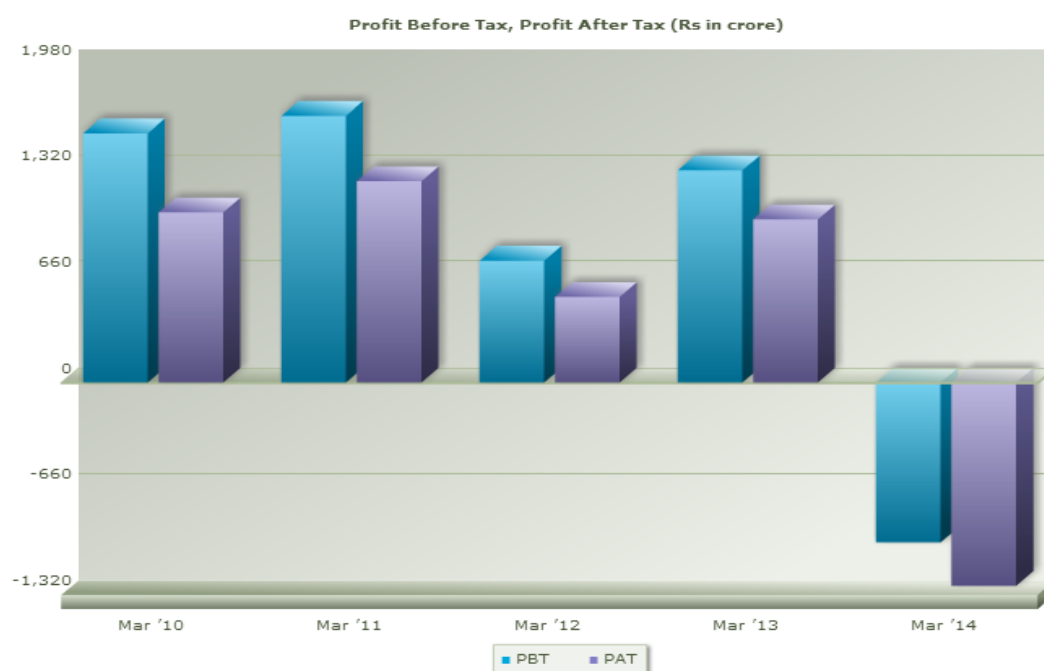


Figure 5. Profit and loss account of Central Bank of India.

growth and displayed healthy growth in key balance sheet parameters for the year ended 31st March, 2014. The profit and loss comparative table is in Table 8 and Figure 6.

OVERALL LOOK AT THE PROFITABILITY AND PERFORMANCE OF BANKS

Public sector banks

Banks include both public sector banks and private sector banks (Tables 9 and 10). Public sector banks are those

where majority stake (more than 50%) is held by the government and public sector banks are those where majority stake is held by the private shareholders.

Conclusion

Banks and Financial institutions play a major role to make our planet a better place to live in. Green bank and environmentally responsible banks do not only improve their own standards but also affect socially responsible behavior of other business. Green banking helps in saving the energy and water consumption and also

Table 8. Profit and loss account of Axis Bank.

	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10
	12 mths	12 mths	12 mths	12 mths	12 mths
Income					
Interest Earned	30,641.16	27,182.57	21,994.65	15,154.81	11,638.02
Other Income	7,405.22	6,551.11	5,420.22	4,632.13	3,945.78
Total Income	38,046.38	33,733.68	27,414.87	19,786.94	15,583.80
Expenditure					
Interest expended	18,689.52	17,516.31	13,976.90	8,591.82	6,633.53
Employee Cost	2,601.35	2,376.98	2,080.17	1,613.90	1,255.82
Selling and Admin Expenses	0	0	0	0	2,443.05
Depreciation	363.93	351.73	342.24	289.59	234.32
Miscellaneous Expenses	10,173.91	8,309.22	6,773.35	5,903.14	2,502.55
Preoperative Exp Capitalized	0	0	0	0	0
Operating Expenses	7,900.77	6,914.23	6,007.10	4,779.43	5,066.76
Provisions & Contingencies	5,238.42	4,123.70	3,188.66	3,027.20	1,368.98
Total Expenses	31,828.71	28,554.24	23,172.66	16,398.45	13,069.27
Net Profit for the Year					
Extraordinary Items	0	0	0	0	0
Profit brought forward	10,029.26	7,329.45	4,969.77	3,427.43	2,348.09
Total	16,246.93	12,508.88	9,211.98	6,815.92	4,862.62
Preference Dividend	0	0	0	0	0
Equity Dividend	939.69	843.86	658.24	573	567.45
Corporate Dividend Tax	161.44	143.37	111.83	97.35	0
Per share data (annualized)					
Earnings Per Share (Rs)	132.33	110.68	102.67	82.54	62.06
Equity Dividend (%)	200	180	160	140	120
Book Value (Rs)	813.47	707.5	551.99	462.77	395.99
Appropriations					
Transfer to Statutory Reserves	1,644.36	1,492.38	1,112.46	836.95	867.43
Transfer to Other Reserves	-0.01	0.01	0	338.85	0.31
Proposed Dividend/Transfer to Govt	1,101.13	987.23	770.07	670.35	567.45
Balance c/f to Balance Sheet	13,501.45	10,029.26	7,329.45	4,969.77	3,427.43
Total	16,246.93	12,508.88	9,211.98	6,815.92	4,862.62

appraises banks in the eyes of environment supporting customers.

As far as green banking is concerned Indian banks are far behind their counterparts from developed countries. If Indian banks desire to enter global markets, it is important that they recognize their environmental and social responsibilities. But, today, many Indian banks are making efforts to "Go Green" through offering various green products and services to their customers and taking initiatives in their day to day business operations for the environmental concerns. These include- Online banking,

mobile banking, ATMs, Electronic fund transfers, Green mortgages, Green credit card, use of solar and wind energy, recycling of paper, Green buildings etc. But still there is a long way to go.

Indian banks need to set their near term and long term green goals, develop their green strategies and execute their greening activities in a phased manner.

This concept of "Green Banking" will be mutually beneficial to the banks, industries and the economy. Not only "Green Banking" will ensure the greening of the industries but it will also facilitate in improving the asset

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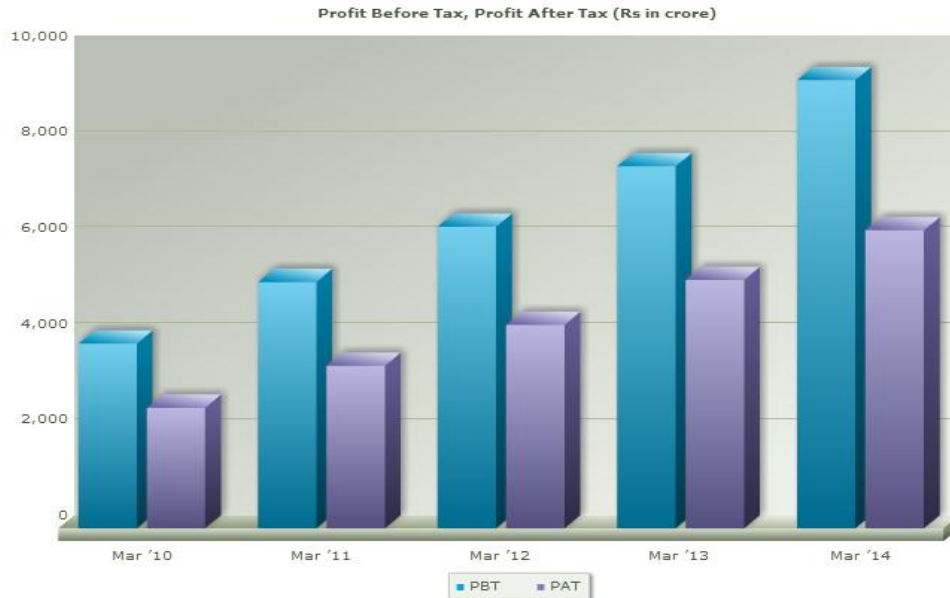


Figure 6. Profit and loss account of Axis Bank.

Table 9. Public sector banks.

Banks	Net Profit (Rs Crore)
State Bank of India	14104.98
Punjab National Bank	4747.67
Bank of Baroda	4480.72
Canara Bank	3282.71
Syndicate Bank	1184.19
Central Bank	1015
IDBI	1,488.4

Table 10 private sector banks.

Banks	Net Profit (Rs Crore)
ICICI Bank	8325.47
HDFC Bank	6726.28
Yes Bank	1617.78
AXIS Bank	5179.43

Conflict of Interests

The author has not declared any conflict of interests.

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quality of the banks in future.

Full Length Research Paper

Effect of climate change on food crop production and vulnerability assessment in Oyo State

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The study assessed household vulnerability to climate change and its effect on yam and cassava production in Oyo state, Nigeria. Primary and secondary data were used for the study. Data on yam and cassava yield between 1990 and 2009 were obtained from the Oyo State Agricultural Development Programme (ADP) while data on climate variables between 1976 and 2010 were obtained from the Nigeria Institute of Meteorology, Oshodi. Primary data on the components of vulnerability that is adaptive capacity, sensitivity and exposure were also obtained from cassava and yam farmers using structured questionnaire to assess their vulnerability to climate change. Multistage sampling technique was employed to select 120 respondents across the three agro-ecological zones of the study area. This was done by purposively selecting five farm villages in each of the three agro-ecological zones in the study area and randomly selecting eight farmers from each of the villages. Trend, regression and principal component analytical tools were used to analyze data collected. The integrated vulnerability assessment approach was adopted using the vulnerability indicator. The result showed that the mean annual temperature and mean annual sunshine hour have been increasing by an average of 0.012°C ($p < 0.01$) and 0.004 hours ($p < 0.01$) per year respectively. This confirms the occurrence of global warming in the study area. The study revealed that sunshine hour significantly ($p < 0.05$) affected yam yield. Household's vulnerability to climate change in the three agro ecological zones as measured by the vulnerability index (VI) was found to be highest in the derived savannah (VI=-0.99) followed by the savannah (VI=0.46) and lowest in the rain forest (VI=0.53). The derived savannah zone recorded the highest vulnerability with a relatively low proportion of the population having access to quality home (2.5%), insecticide (30%), fertilizer (30%), improved seedlings (30%), road (15%), health services (15%), primary and secondary schools (15%), veterinary services (0.03%), food market (42.5%), and microfinance institutions (0.03%). The study recommended among others that crop-breeding researchers should work towards developing improved varieties of cassava and yam that can cope with future expected change in climate. Also, integrated rural development schemes aimed at increasing access to basic social amenities should be established by the government with the cooperation of the residents as this will improve adaptive capacity and thereby reduce vulnerability of farmers to climate change in the study area.

Key words: Climate change, Vulnerability, Food, Crop production, Oyo State

INTRODUCTION

Climate change refers to the variation in the global or regional climates over time. It describes changes in the

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variability or average state of the atmosphere over time scales ranging from a decade to millions of years (Adejuwon, 2004). Climate change may result from factors such as changes in orbital elements (eccentricity, obliquity of the ecliptic, precession of equinoxes), natural internal processes of the climate system or anthropogenic forcing (for example, increasing concentration of carbon dioxide and other green house gases) (Agbola et al., 2007).

Vulnerability to climate change can be explained as the adaptive capacity to climate change less sensitivity and exposure.

Vulnerability = (adaptive capacity) – (sensitivity + exposure)

West Africa is one of the most vulnerable to the vagaries of the climate, as the scope of the impacts of climate variability over the last three or four decades has shown Intergovernmental Panel on Climate Change (IPCC, 2007b; Apata et al., 2009). Recent food crises in countries such as Nigeria are reminders of the continuing vulnerability of the region to the vicissitudes of climatic conditions.

The objectives of this study are to:

- i. assess the household vulnerability to climate change in the study area
- ii. determine the effect of climate change on the yield of yam and cassava
- iii. examine the trend of climate elements (rainfall, temperature, relative humidity, and sunshine hour) over the years

METHODOLOGY

The study area is Oyo state Nigeria. Time series data on weather variables were collected over a period of 35 years (1976-2010) from Nigeria meteorological society (NIMET). The time series data included the annual rainfall, annual temperature mean, annual relative humidity mean, and annual sunshine hour mean in Oyo state over the time period. Time series data on the annual yield of Yam and cassava in Oyo state over a period of 20 years (1990-2009) were also collected from the Oyo state Agricultural development project (ADP) office. The study was restricted to using a 20 year time series because data on annual yield before 1990 were unavailable. Yam and cassava were chosen because they are the major crops grown in the area. With respect to the primary data used for the study, multistage sampling technique was employed to select 120 respondents across the three agro ecological zones of the study area. This was done by purposively selecting five farm villages in each of the three agro ecological zones in the study area and randomly selecting eight farmers from each of the villages.

Method of analysis

Descriptive, trend, regression, and principal component analysis were all used to analyse the data.

The trend model is of the implicit form $C_i = f(T, e)$ and was subjected to linear, quadratic, cubic, power, semi log, exponential functional forms to determine the best based on the value of the adjusted R^2

C_i = climate variables

T= time

e= error term

The regression model is of the implicit form $Y=f(X_1, X_2, X_3, X_4, X_5, e)$

Y= Annual crop yield (for yam and cassava) (Kg/Ha)

X_1 = Total annual rainfall/precipitation (mm)

X_2 = Mean Annual temperature ($^{\circ}$ C)

X_3 = Mean Annual relative humidity (%)

X_4 = Mean annual Sunshine hour (hours)

X_5 = Time period

Vulnerability is calculated as the net effect of adaptive capacity, sensitivity and exposure.

Vulnerability = (adaptive capacity) – (sensitivity + exposure)

It is however necessary to attach weights to the indices and this was accomplished using the principal component analysis (PCA). PCA is frequently used in research that is based on constructing indices for which there are no well defined weights. The use of asset-based indices for measurements of wealth across different social groups is a good example (Filmer and Pritchett, 2001; Langyintuo, 2005; Sumarto et al., 2006; Vyas and Kumaranayake, 2006). As with the asset based indices for wealth comparison, there are no well-defined weights assigned to the vulnerability indices chosen for this research work; therefore a statistical method (PCA) was employed to generate the weights. The indicators used for the analysis and their unit of measurement are shown in Table 1.

RESULTS AND DISCUSSION

Trend of annual rainfall

Statistical record of rainfall in Oyo State of Nigeria between 1976 and 2010 shows an increasing trend with the highest in 1996 and lowest in 1983. The value of the highest volume of rainfall which was recorded in 1980 was 1967.7mm while the lowest was recorded in 1983 with value of 865.4mm and the mean and standard deviation of the rainfall data in the zone from 1976-2010 are 1298.06 and 238.05 mm respectively. The standard deviation shows that there is a large variability in the amount of rainfall from year to year. The coefficient of correlation between rainfall and time has a value of 0.121, implying that there is a weak positive relationship between rainfall and time. This correlation is however not statistically significant.

Trend of annual temperature mean

Data on temperature from 1976-2010 shows an increasing trend with the minimum temperature (26.09° C) recorded in 1976 and maximum temperature (27.79° C) recorded in 1998. The mean value of temperature and its standard deviation over the period are 27.11° C and 0.379° C, implying that there is a slim variability in temperature values from year to year. The trend coefficient is 0.012 and is statistically significant at 1%. The coefficient of correlation of temperature and time is 0.715 and is statistically significant at 1%, implying that temperature

Table 1. Descriptive and trend analysis of data on climate from 1976 – 2010.

	Rainfall (mm)	Temperature (°C)	Relative humidity(%)	Sunshine h
Mean	1298.06	27.11	65.35	4.911
Standard deviation	238.05	0.379	7.402	0.304
Maximum value	1967.7	27.79	72.83	5.81
Minimum value	865.4	26.09	42.33	4.38
Trend coefficient	0.025	0.012 ^{xxx}	-0.037	0.004 ^{xxx}
Correlation coefficient	0.121	0.715 ^{xxx}	0.243	0.613 ^{xxx}

*** significant at 1%. Source: NIMET, Oshodi and Computer printout of SPSS result.

has significant positive relationship with time. Therefore, temperature changes with time significantly. The warming is real and significant.

Trend of annual relative humidity mean

Relative humidity record of the study area from 1976-2010 shows a decreasing trend with its highest value for the period (72.83%) recorded in 1979 and lowest value (42.33%) recorded in 2001. The mean and standard deviation values of the relative humidity over the period are 65.35 and 7.402%, implying that relative humidity has a considerable variability from year to year. The trend coefficient is 0.037 and it is a decreasing trend. It is however also statistically insignificant. The coefficient of correlation has a value of 0.243, showing a weak negative relationship between relative humidity and time; also it is statistically insignificant.

Trend of annual sunshine hour mean

Sunshine duration data 1976 and 2010 show an increasing trend with a trend coefficient of 6.972 h per year and is statistically significant at 1%. The maximum value of sunshine hours (5.81 h) was recorded in 2001 while the minimum (4.38 h) was recorded in 1983. The mean and standard deviation values over the period are 4.911 and 0.304 h, implying that there is a narrow variability in the value of sunshine hours from year to year. The trend coefficient is 0.004 and is statistically significant at 1%. The coefficient of correlation is 0.613, indicating that there is a strong relationship between time and sunshine hours; also it is statistically significant at 1%.

Food crop trend

Yam and cassava yield show a decreasing trend with a trend coefficient of 237.345 and 424.249 kg per hectare per year respectively. Trend of yam yield is statistically significant at 1% while trend of cassava yield is not statistically significant. The maximum value for yam yield (18892.83kg/ha) and cassava yield (11868.71kg/ha) were

recorded in 1992 and 1991 respectively while the minimum values for yam yield (9304.00kg/ha) and cassava yield (7032.62kg/ha) were recorded in 2008 and 1998 respectively.

Effect of climate on cassava yield

In order to determine the effect of climate change on cassava yield, a model was subjected to regression analysis in four functional forms (linear, semi-log, exponential and double-log functional form). The semi-log function was chosen as the lead equation ($Y = -159769.912 + 4016\ln X_1 + 49074.724\ln X_2 - 2210.773\ln X_3 - 13974.645\ln X_4 - 854.105\ln X_5$) for further discussion because it has the highest adjusted R^2 value, and also has the highest F – ratio value (0.894). The result of the semi-log form shows that the coefficient of multiple determination (R^2) is 0.242 (24.2%), implying that the independent variables (X_1, \dots, X_5) jointly explained 24.2% of variation in cassava yield. Consequently, the interpretation of the results of the regression indicates the following:

Rainfall (X_1) and Temperature (X_2) were positively related to cassava yield; however, they were not significant statistically.

Relative humidity (X_3), Sunshine hour (X_4) and Time (years) (X_5) have a negative relationship with cassava yield but it is not statistically significant.

The F-ratio which determines the overall significance of the regression is not statistically significant at the 10% level as F-calculated value (0.894) is less than F-tabulated value. We therefore conclude that there is no significant relationship between climate change and cassava yield. Cassava is not affected by climate change as shown in the result. Cassava planting can therefore serve as a viable alternative for farmers living in areas prone to climate change so that they can have something to fall back on in times when other crops fail.

Effect of climate change on yam yield

The model was subjected to regression analysis with four

Table 2. Predicted future values of climatic variables.

	2020	2030	2040	2050
Temperature (°C)	27.51	27.58	27.64	27.68
Rainfall (mm)	1313.13	1319.73	1325.25	1330.00
Humidity (%)	62.06	61.60	61.22	60.90
Sunshine (H)	5.50	5.73	6.00	6.20

Source: Derived by the Researchers.

functional forms (semi-log, double-log, exponential and linear functional forms). The semi-log form was chosen as the lead equation ($Y=141024.414+2522.765\text{Ln}X_1-11434.344\text{Ln}X_2-9940.463\text{Ln}X_3-38020.236\text{Ln}X_4+1641.322\text{Ln}X_5$) because it has the highest adjusted R^2 value (0.446), and also has the highest F-calculated (4.058). The coefficient of multiple determination (R^2) has a value of 0.592 (59.2%), implying that the independent variables jointly accounted for 59.2% of the variation in yam yield.

Rainfall (X_1) is positively related with yam yield, implying that as rainfall increases yam yield increases, and vice versa. The result revealed that a unit increase in rainfall, keeping all other variables constant will result to 2522.765 unit increase in Yam yield. This effect is in agreement with the *a priori* expectation. The effect is however statistically insignificant as t-calculated value (0.853) is less than the t-tabulated value at 1, 5, and 10%.

Temperature (X_2) has a negative relationship with yam yield, implying that temperature increase will result in decrease in yam yield and vice versa. The relationship is however not statistically significant as the value of t-calculated (0.181) is less than t-tabulated value at the 1, 5 and 10% levels of probability.

Relative Humidity (X_3) is negatively related to yam yield. This means that a unit increase in sunshine duration (sunshine hour), keeping all other variables constant will result to 9940.463 unit decrease in Yam yield. This effect is statistically significant at 10% level of probability as t-calculated value (2.037) is greater than t-tabulated value (1.677) at 10% level of probability.

Sunshine duration (X_4) has a negative relationship with yam yield. The result revealed that a unit increase in sunshine duration (sunshine hour), keeping all other variables constant will result to 38020.236 unit decrease in Yam yield. This relationship is statistically significant at 5% level of probability as t-calculated value (2.775) is greater than t-tabulated value at 5% level of probability.

Time (years) (X_5) has a negative relationship with yam yield that is the yield reduces with time but it is statistically insignificant as the t-calculated value (0.800) is less than t-tabulated value (1.699) at 10% level of probability.

The F-ratio which determines the overall significance of a regression is statistically significant at 5% level of

probability as F-calculated value (4.058) is greater than F-tabulated value. We therefore conclude that climate change significantly affected yam yield.

Predicted future values of climatic variables

The projections for values of climate variables derived from the trend models for rainfall, temperature, relative humidity, and sunshine respectively is presented in Table 2.

The table reveals that by 2020 the average temperature of the state is projected to have a value of 27.51°C and by 2030, 2040, 2050 temperature values are expected to be increasing from 27.58°C to 27.64°C and to 27.68°C respectively. The table also reveals that rainfall in the zone is predicted to have the following values from 1313.13, 1319.73, 1325.25, and 1330.00 mm in 2020, 2030, 2040, and 2050 respectively. This implies that values of rainfall are projected to be increasing signifying that floods could be experienced in the zone in the future if the trend continues. Relative humidity will have values decreasing from 62.06% in 2020, 61.60% in 2030, 61.22% in 2040, and 60.90% in 2050. For sunshine hours, the values are expected to be increasing from 5.50 h in 2020, 5.73 h in 2030, 6.00 h in 2040, and 6.20 h in 2050.

The optimal range of each of the climate variables for the growth of yam and cassava is presented in Table 3. The table reveals that the optimal range of rainfall for the growth of yam and cassava are 1700 – 3000 mm and 1700 – 2500 mm respectively. The table also shows that the optimal range of temperature for the growth of the crops is 25 – 30°C for yam and cassava. The optimal range of relative humidity for the growth of the crops is 75-80% for yam and cassava, while the optimal range of sunlight hours for the growth of both crops is 4-5 h.

Comparing Tables 2 and 3, it can be inferred that the projected values of the climatic variables in the future do not fall within the optimal conditions for the growth of cassava and yam except for the temperature. This implies that by 2050 the projected climatic conditions then will not be favourable for optimal growth of yam and cassava. This is consistent with the findings of Molua and Lambi (2007) in Cameroon, Deressa et al. (2008a and 2008b) and Yesuf et al. (2008) in Ethiopia, Adejuwon

Table 3. Optimal climatic conditions for the growth of yam and cassava.

	Rainfall (mm)	Temperature (°C)	Humidity (%)	Sunshine (H)
Yam	1700 – 3000	25 – 30	75 – 80	4 – 5
Cassava	1700 – 2500	25 – 30	75 – 80	4 – 5

Table 4. Factor scores of the first principal component.

Vulnerability	Factor Scores
Ownership of livestock	-0.053
Ownership of radio	0.079
Quality of house	0.075
Non agricultural income	-0.070
Insecticide and pesticide supply	0.080
Fertilizer supply	0.070
Improved seeds supply	0.078
All weather roads	0.059
Health services	0.078
Telephone services	0.047
Primary and secondary school	0.080
Veterinary services	0.075
Food market	0.080
Microfinance	0.069
Literacy rate	-0.059
Frequency of extreme climates	-0.064
Change in Temperature	0.009
Change in precipitation	0.009
Eigen value	12.524
Proportion of variance	69.576
Cummulative proportion	69.576

Source: Computer printout of SPSS result.

(2004) in Nigeria.

Vulnerability assessment

For the analysis, principal component analysis (PCA) was run on the indicators listed in Table 4 using data analysis and statistical software (SPSS).

The PCA of the data set on vulnerability indicators revealed two components with eigen values greater than 1. These two components explain 100 percent of the total variation in the data set. The first principal component explained most of the variation (69.576 percent) and the second principal component explained 30.424 percent.

Based on earlier argument for the use of PCA, in constructing indices, the first principal, which explained the majority of the variation in the data set was chosen. It was observed from the factor scores that the first PCA (the vulnerability index, in this case) was positively associated with the majority of the indicators identified

under adaptive capacity and negatively associated with the indicator for sensitivity. It is however not negatively associated with the indicators categorised under exposure because the three districts have similar temperature and rainfall amount. Thus for the construction of the vulnerability indices, the indicators of adaptive capacity which are positively associated with the first PCA and the indicator of sensitivity which is negatively related were selected. This reduced the indices remaining to just thirteen. Higher values of vulnerability index show less vulnerability and vice versa.

The factor scores from the principal component in Table 4 were then employed to construct indices for each agro ecological zone.

Figure 1 shows the vulnerability index for each agro ecological zones.

Figure 1 shows that the net effect of adaptation, exposure and sensitivity is positive for the rainforest and Savannah zones while it is negative for the derived savannah zone. This indicates that household

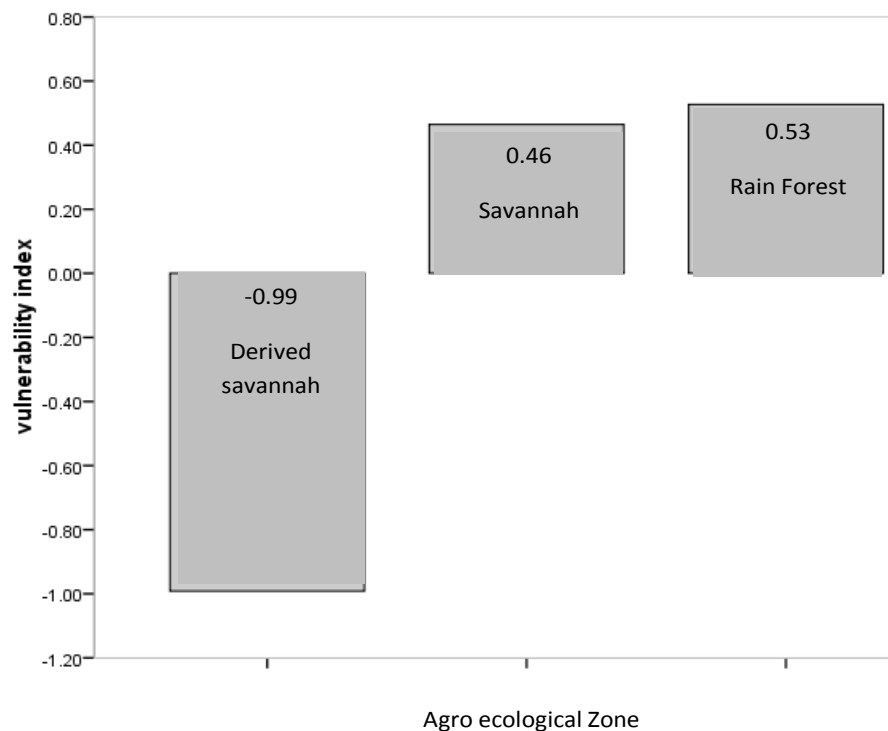


Figure 1. Vulnerability indices of the three agro ecological zones in Oyo State.

vulnerability was found to be highest in the derived savannah (VI=-0.99) followed by the savannah (VI=0.46) and lowest in the rain forest (VI=0.53).

Conclusion

From the study, it can be concluded that the much publicized global warming is real. It is also evident that there is high negative correlation between humidity and sunshine hour.

The increasing trend of rainfall also puts the area at the risk of flooding in the future if proper environmental norms are not adhered to.

It can also be concluded that yam yield is much more affected by climate change in contrast with cassava yield. Vulnerability was calculated as the net effect of sensitivity and exposure on adaptive capacity. The derived savannah zone recorded the highest vulnerability with a relatively low proportion of the population having access to quality home (2.5%), insecticide (30%), fertilizer (30%), improved seedlings (30%), road (15%), health services (15%), primary and secondary schools (15%), veterinary services (0.03%), food market (42.5%), and microfinance institutions (0.03%).

RECOMMENDATION

The government of Oyo State should enforce

environmental laws that will forbid citizens from dumping refuse in drainages, that is, proper waste disposal management so as to forestall the incidence of flooding as the amount of rainfall is projected to rise in the future.

Farmers are to ensure that their farmlands are well drained to avert the disaster of water logging and flooding.

Farmers should be encouraged to plant cassava as an insurance against climate hazard as cassava was found to be least affected by climate change.

Researchers in the field of plant breeding should work towards developing varieties that would be able to adapt or cope with the effects of the expected change in climatic variables.

The scale of analysis for the study on vulnerability is at the agro ecological zone level which is highly aggregated. Each zone included in this study covers a very wide area of land characterized by different biophysical and socio economic attributes. These variations within each agro ecological zone should be considered in order to target areas that are very vulnerable and to recommend appropriate interventions. Future research should focus on local levels, especially Local government or village levels, where the actual dynamics of vulnerability to climate change take place.

In general, house hold vulnerability to climate change in Oyo state is highly related to poverty (loss of coping or adaptive capacity) in the zone that was indicated as vulnerable. Integrated rural development schemes aimed

at increasing access to basic social amenities should be established by the government with the cooperation of the residents as this will improve adaptive capacity and thereby reduce vulnerability of farmers to climate change in the study area.

Conflict of Interests

The authors have not declared any conflict of interests.

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