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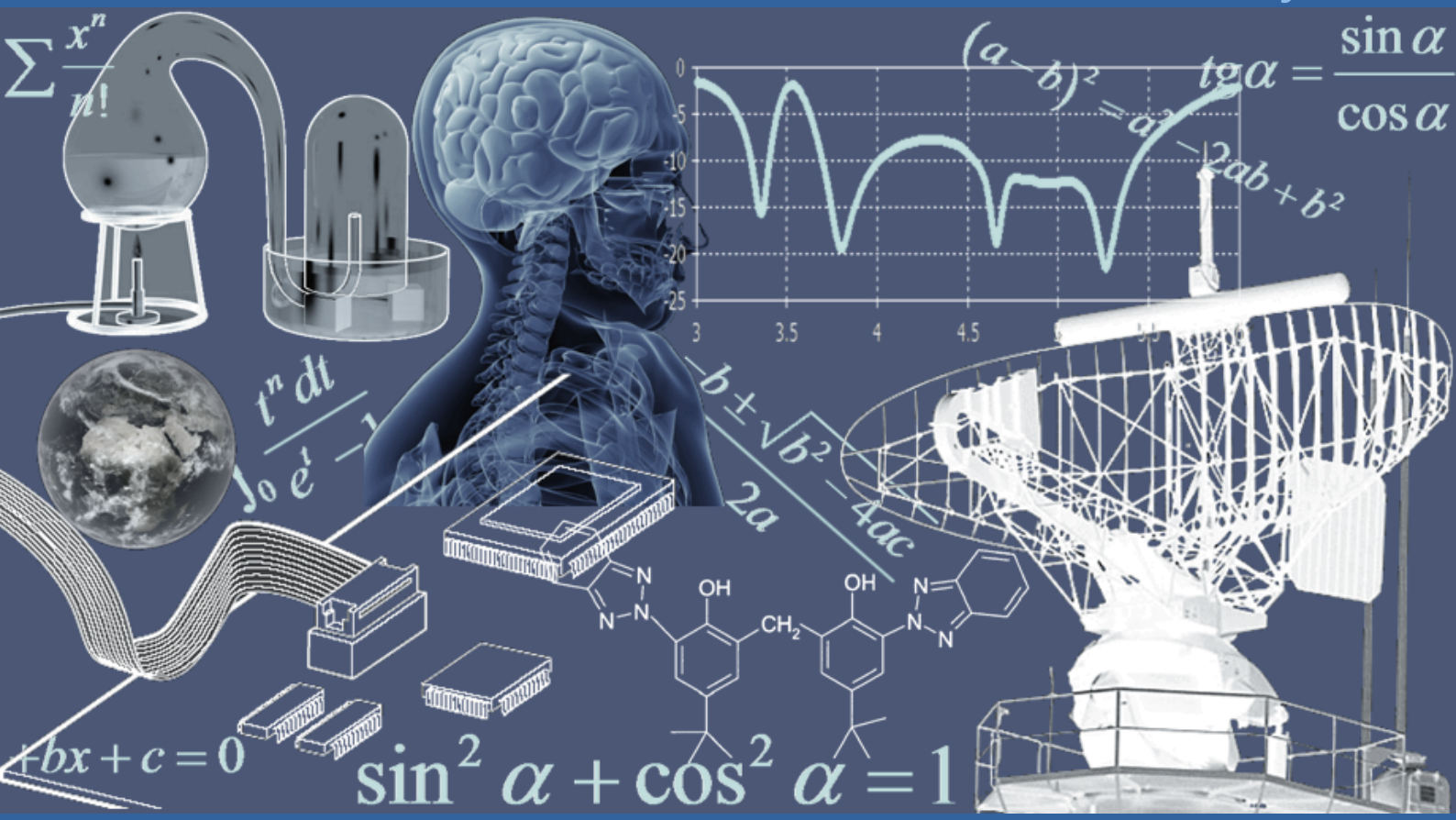

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Modeling of condensate water system in a nuclear power plant with new control strategy using Dymola/Modelica

Jibran Baladi, Naeem Ullah Khan, Muhammad Junaid Rabbani, Muhammad Shoib Khan, and Syed Muhammad Amaad Asghar

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ABSTRACT: This paper is focused on modeling and introducing a new control strategy for a condensate water system. Current control strategy of the system is simple feedback control system with one PID controller. Results of current control strategy were taken into account for improvements in terms of system stability, valve movements and unwanted transients. Problems found in condensate system were; large variations in process variable, extra movement in valve positions and inefficient opening of valves. Simulation model with current control strategy and results as of real power plant was created and validated, as new control strategy can be applied and results can be compared. The main recommendation to improve the control system performance was found through PID cascade control strategy that could assist the current controller. The recommendation was evaluated by designing and implementing the cascade control strategy on the Dymola simulation model. Simulation results pointed out considerable increase in system performance according to the requirements of Ringhals (Vattenfall) AB Sweden.

KEYWORDS: Condensate, valve movements, validated, Dymola, transients.

1 INTRODUCTION AND OBJECTIVES

This research is done in Vattenfall AB Sweden which is a leading European power generation company, whose main product is electricity. After major maintenance efforts for an extensive modernization of monitoring, control equipments and upgrade from analog to digital I&C system it was observed that few valves in different control loops had some strange behaviors. These uneasy and constant movements in the valves will probably wear out the life of the valve even before its expected time, which would result in a large maintenance cost and shutdown. In order to even service these valves, part of the turbine or the entire turbine must be taken out of service which will lead to a large repair cost. These valve movements and resulting flow transients will further carry to unnecessary oscillations and challenges to the other parts of the plant, thus reducing overall strength and durability. The preliminary aim of this research is to perform a detail study of control loop (condensate water system) at nuclear power plant documented by Westinghouse Electric Corporation. Subsequently, after studying details of this system the ultimate goal was to investigate how the overall performance of condensate system could be improved by implementing a much more refined control strategy. The recommended control strategy should maintain performance, minimize valve movement and the range of level amplitude should be allowed to change $\pm$ 5% [1]. Another side goal of this research is to implement a tracking logic in the simulated model such that, whenever main valve or pump breakdowns, emergency valve should open instantly. After implementing the recommended control strategy, objectives are achieved as required. To achieve these tasks, a simulation model was developed for the control loop to construct and evaluate the new control strategy.

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1.1 CONDENSATE WATER SYSTEM (DRAINAGE SYSTEM)

Condensate water system contains a water tank whose level is controlled by two valves main valve and emergency valve. Basically, this control system in nuclear power plant has total four pair of valves so it is obvious that the modeling and controlling improvement techniques implemented on one pair of control loop can also be implemented on other pairs.

As two valves (main and emergency valve) are connected to control the water flow from tank, main valve (V141) is operating under a normal condition when PID controller output is 50% or below 50% and the emergency valve (V131) is used when PID controller output increases above 50%. PID (proportional, integral and differential) controller which is previously implemented in this control loop is generating a control signal to stabilize given set point valve (demand signal or required level of the tank) and this PID controller's output is controlling the positions of both the valve accordingly. The strict condition for these valves are that when the PID controller output increases from 0% to 50% then control valve V141 should start opening from 0% to 100% respectively. Further, if the controller output increase above 50% then the emergency valve V131 should start opening in a similar manner as V141. Likewise, once the controller output start decreasing, emergency valve V131 should be fully closed first then valve V141 should start to closing. The maximum operating power is 450MW; power for LTDP (low pressure drainage pump) to start is approx 230MW and its stops at 15% of the maximum power which is 67.5MW. Fundamental reasons causing instability are unwanted variations in existing controller, which causes variation in valves and main reason is that existing controller has no knowledge of tank outflow measure and variations in input flow. Condensate system plays significant role in power plants and due to its failure whole power plant can collapse [2].

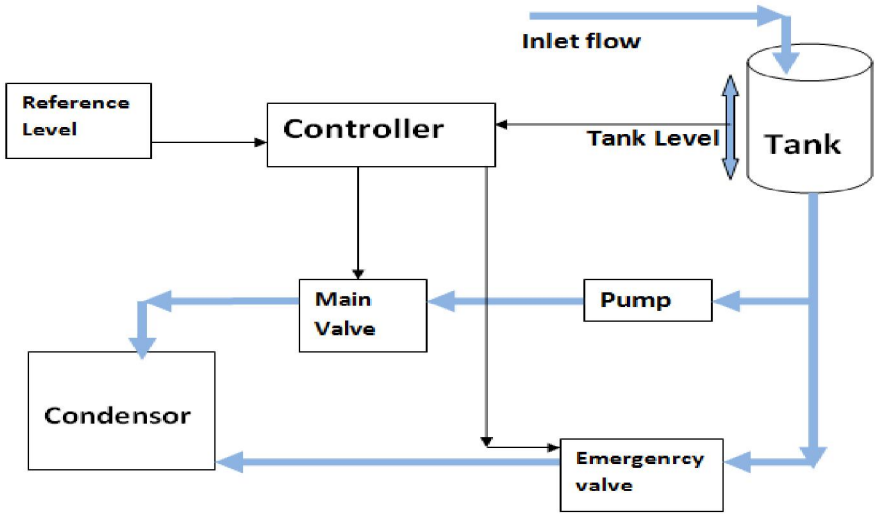

Fig. 1. General block diagram of condensate water system

2 SIMULATION MODEL

A simulated model of the system is developed with detailed modeling design in the simulation language called Modelica using its graphical tool Dymola. The entire control loop and its each model component are modeled after studying and understanding its technical AutoCAD drawings, documented data, system description and datasheets provided at Ringhals nuclear power plant. The model is built in a hierarchical manner and every component and complete model is validated against the data available from the real plant. Simulation model with new control strategy is given in figure2

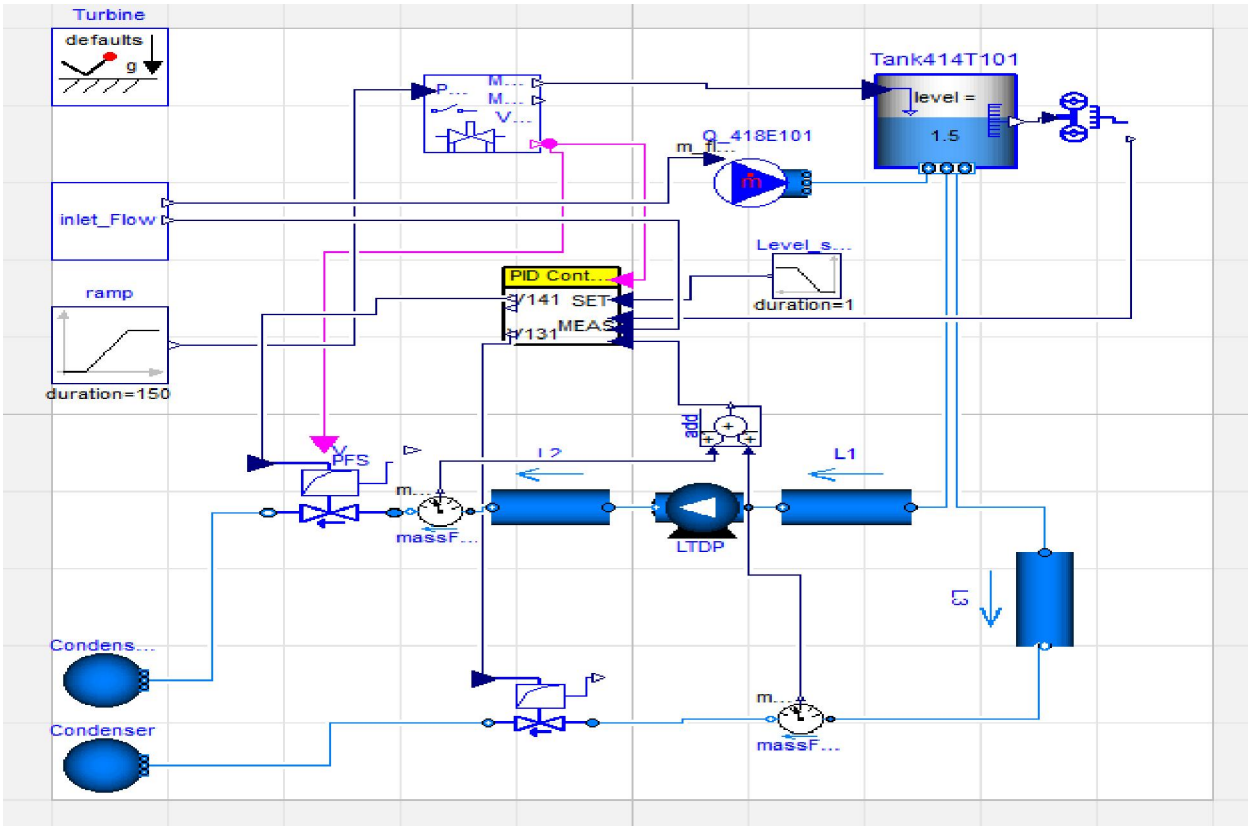

Fig. 2. Simulation model of condensate water system in Dymola/Modelica

Main simplifications in model are turbine logic, valves and inlet flow. In turbine logic block, initial signal distribution is made on basis of input power; user decides start and stop of power and pump from this block. Simplification in valves is also made in sense that simple valves were used from Modellica library and their transfer function were used such that; valve output should be acting similar to real valve in plant. In valve V141, characteristic curve was introduced to make soft valve similar to real valve. In real plant main flow to tank T101 is coming from valve V287 and moisture separator. These flows are simplified in sense that flow from valve V287 is created using a table and flow from moisture separator was taken as constant value because it changes very slightly and mostly remains close to chosen value that is 50kgs/sec. This simplification was done because V287 is further connected to other components like tank 102, pumps and so on and it is not possible to model all [3].

2.1 SIMULATION MODEL DESCRIPTION

Figure 2, shows simulation model of a condensate water system; main objective of this model is to control level in the tank at a desired level using control valve and emergency drainage valve for water drainage. Model is operating at maximum input power of 450 MW, tank input pressure from turbine logic is approx 4.5 bar and input flow from valve V287 (approx 73kg/sec) and from moisture separator is 123 kg/sec. Inlet flow block (V287 and moisture separator) is then connected to mass flow component to generate and supply water flow to the tank. Level in the tank is measured with level gauge and this measured level is applied to PID controller where it compares measured level with desired level (set point) and generates control signal for both connected valves. Control valve V141 is the main valve and operates in normal conditions while V131 is emergency valve which operates when controller output increases above 50%. Both valves are connected with PID controller through appropriate logics with the help of different Modelica blocks and their operation is according to control signal generated. PID maintains required level in the tank through valves (V141 and V131) where LTDP is used to pump water from the tank through control valve V141. Finally flow from both valves ends at condenser in the simulated model as shown in figure 2. Implemented new PID cascade control strategy (Inner model of PID Control block in figure 2) can be observed in figure 3 below

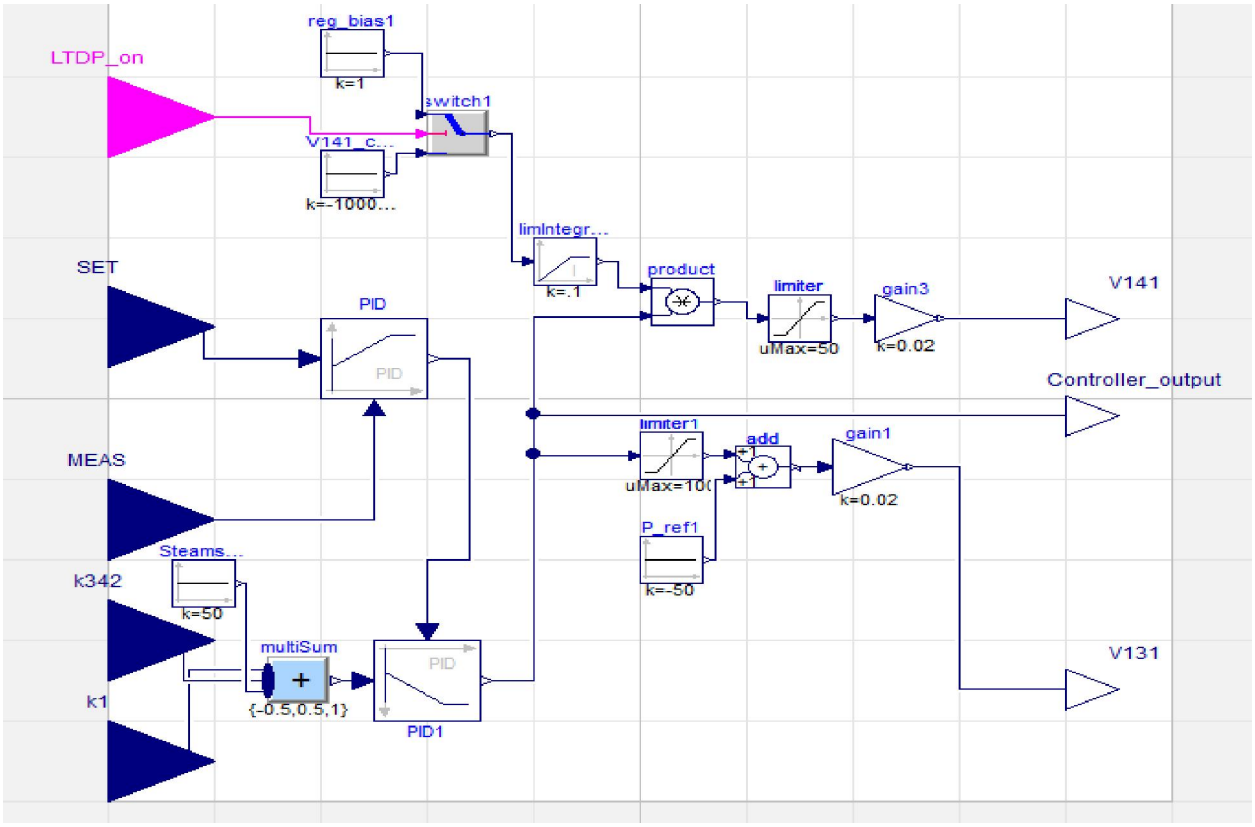

Fig. 3. PID Cascade controller design in Dymola

2.2 SIMULATION MODEL BOUNDARIES AND SIMPLIFICATIONS

As this condensate water control loop model does not cover the entire system of the plant except the required particular section, so the other parts of the system which are affecting this loop in a smaller manner are modeled as approximate constant values. Therefore, condenser is modeled as a constant pressure source and its pressure normally varies a very little with turbine power and with sea water temperature. Moreover, flow fluctuations are expected to be very small and slow to cause any pressure change, so it is neglected in this model. The pressure in T101 was modeled as a function of turbine power and is independent of the flow to the tank. The tank is in contact with a large steam volume and the level fluctuations in the tank are relatively small. The dynamic behavior of steam pressure is much slower than the regulating system so the error in the model is considered negligible.

3 MODEL VALIDATION

Simulation model of the condensate water system with validated valves and pump was validated against the real plant data all initial condition of real plant and simulation model are approximately same. For this procedure, real plant parameters and specifications were set similar in the simulation model such as PID control parameters (P=1.67, I=36, D=.00001), input power of 450MW, real input flow data of value V287 and with same set point [4]. Model was simulated with these parameters and the evaluated data was compared with the real plant data as shown in Figure 4. To get these results initially developed model in Dymola with one PID as similar to real system was simulated with same above mentioned values, it was to validate that simulation model works in similar manner as of real plant, and Figure 4 is a combined plot of simulated model and real plant developed in Matlab.

From Figure 4, it can be observed that process variable of the simulation model is oscillating in the start as compared to the process variable of the real plant. Reason for the process variable of the real plant being stable is that the obtained data is of running plant where the process variable was already in steady state compared to simulated model response. Initially control signal is high which causes high opening degree of V141 and due to which level oscillates in the start.

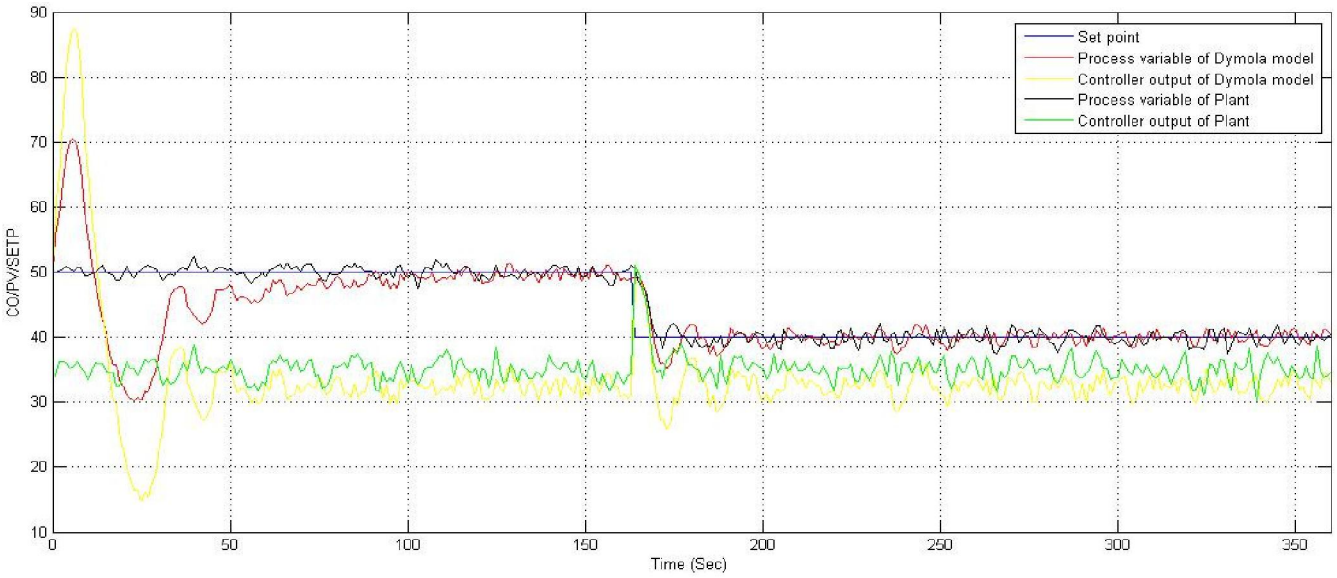

Fig. 4. Condensate water system validation step response test.

Level starts to reach the desired value as controller reads error signal and generates signal for actuators, it takes approx 50 seconds for level to reach at required set point where it follows set point with similar fluctuations as of real plant. Moreover, it can be analyzed that the dynamics of the Dymola model response is relatively close to the real plant.

4 RESULTS

Model response with cascade control strategy is shown in Figure 5. It can be observed that level is following the desired set point with low fluctuations (max +-2%). There is a step change at 225 seconds from 50% to 40%. As required level drops 10 units, controller observes error signal and generates a new signal to reach the new set point value. As it is always been a give and take between controller speed and performance, in our case both controller speed and performance are good enough.

Small fluctuations in process variable (measured tank level) are due to change in input flow with time, inflow is varying continuously and remains close to 123 kg/sec but due to varying amount level of the tank changes and level sensor reads level every second and due to which small fluctuations appear.

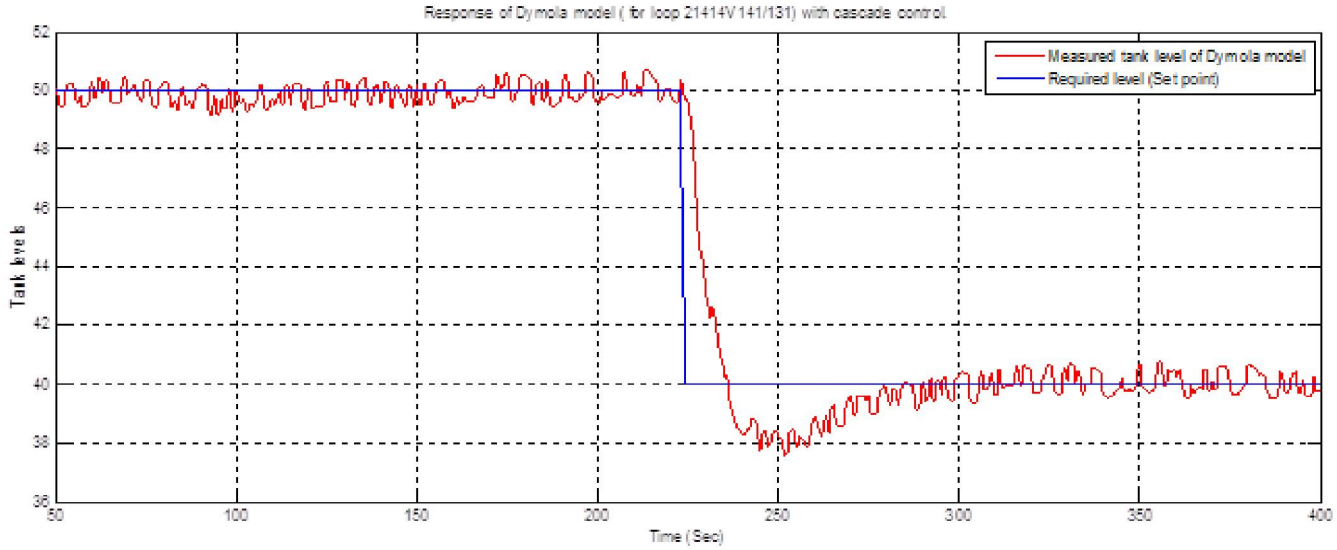

Fig. 5. Response of condensate water system simulation model

In Figure 6, response of simulated Dymola model with cascade control design is compared with the response of real plant with existing single PID feedback controller. The step change is introduced at 225sec as a decrease from 50% tank level to 40%. Real plant response and simulated cascade control output can be seen in Figure 6. Data used for real plant is of same control loop but at different time so there is different step change, however it does not affect results in any form but only used to see how better improved results are. There is a clear improvement in level response; a lot of oscillations have been eliminated due to the compensating behavior of the cascade control. From the graph, we can see that cascade control reacts in an appropriate way. Though, the speed of the cascade controller is similar but there is a longer under-shoot compared to real plant but this under shoot is well within the reasonable limits of this system.

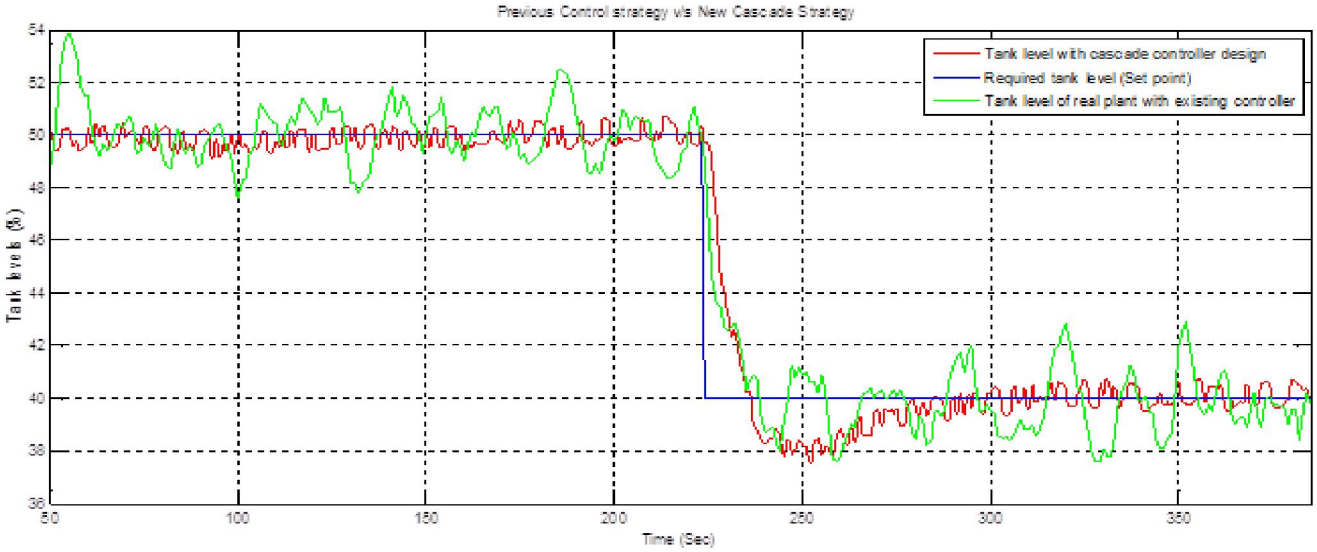

Fig. 6. Comparison between existing and suggested controller technique.

Figure 7 shows efficient opening of emergency valve when LTDP trips at time 200 seconds. LTDP is tripped by force at mentioned time, due to which main valve V141 starts closing and controller increases its output to put emergency valve V131 in operation as tank level can be maintained. LTDP trip occurs when power decreases below 230 MWs and again it starts operation when power increases above 230 MWs.

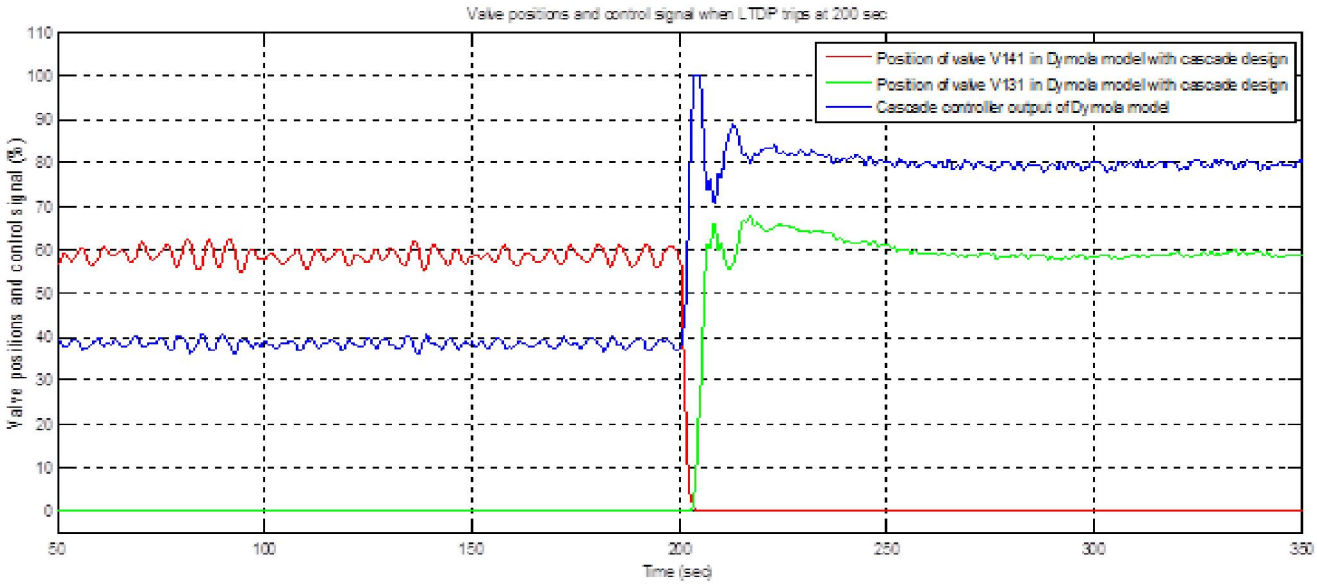

Fig. 7. Efficient opening of emergency valve when LTDP trips at 200 sec

5 CONCLUSION

Simulation model was validated against real control loop data at different transients and has showed that the simulated model is a decent approximation of the real plant with relatively similar dynamics. Once the model was analyzed, variations in inlet flow to tank were found to be the major disturbance, preliminary solution was to design an accurate inlet flow (from V287 and moisture separator) to the tank and add some filtration to existing PID controller but it was not sufficient to meet required results, after studying different control strategies it was concluded that PID cascade technique will be more appropriate for this control loop, other techniques were not suitable due to complexity of system and due to lack of accurate mathematical model. Most promising solution was to implement PID cascade design in connection to existing controller. Simulation results using cascade design showed that the controller is more responsive and stable. It behaves smoothly during step changes and huge flows and simulated results using cascade control showed more stable system performance and results.

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AUTHORS INTRODUCTION

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Benefits of Community Based Organizations for community development

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ABSTRACT: The research is based on comparative study which evaluates performance of various Community Based Organizations in different localities of Nowshera Kalan (Pakistan) after 2010 floods which devastated the whole region, with the aim to find relationship between Community Based Organizations and community development. After 2010 floods, people in Nowshera Kalan were facing too many problems for removing mud, dead animals and repair and cleaning of houses. Many national and international nongovernmental organizations intervened to help the affected people but they were unable to contact any elder or representative from each locality. These nongovernmental organizations had encouraged these community based organizations for each locality and then provided them financial support and resources for restoration and reconstruction of lifelines and livelihoods. For this research, progress reports of Various Community Based Organizations in the study area were studied who worked in different areas like education, public health, WATSAN (Water and sanitation), public awareness, sustainable livelihood and social welfare of the community. The study found that there is strong relationship between Community Based Organizations and community development. Educating and Encouraging local population about the importance of community based organizations and its role in problem solving of a particular community is of utmost importance. The study highlights visible changes among the two communities having and lacking these organizations. They can play vital role in community development if funds are provided and enhanced their capacities and resource base.

KEYWORDS: Livelihood, Impact, Water and sanitation, healthcare, community development.

1 INTRODUCTION

Community based organizations (CBOs) are represented with different names in different regions like community development associations, societies, welfare organizations, neighborhood councils and united community [1]. People working in the same environment irrespective of their creed, culture and religion set up these organizations for collective benefits and wellbeing. These are localized institutions in nature and its membership is based on equality with an aim of socioeconomic welfare of the concerned community [2]. Being non-profit and non-governmental localized institutions, they depend on its members for financial needs for the fulfillment of its responsibilities and do not look towards government for funds [3]. All benefits gained from members' contributions to the associations are shared accordingly with fairness.

In 2010 Pakistan floods, Nowshera Kalan in District Nowshera was completely submerged in flood water and severely devastated. To meet challenges offered by flood, people in different localities formed community based organizations (CBOs) to overcome different challenges.

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Fig. 1. Nowshera Kalan, District Nowshera, Khyber Pukhtunkhwa, Pakistan

The objective of this study is to find the relationship between existence of CBOs and community development and to compare the changes in two areas i.e one with having CBOs (Nowshera Kalan) and the other where no CBOs were formed (Aman Garh).

2 COMMUNITY DEVELOPMENT

Community development is the planned evolution of economic, social, environmental and cultural aspects of community well-being [4]. CBOs' members are considered well-informed and skillful in core areas of community interventions such as development of goals and objectives, problem identification, planning and implementation [5]. Community development can be termed as a change process of improvement and empowerment in the situation of community members in social, economic, physical and environmental respects and to keep its sustenance in future.

3 METHODOLOGY

Being a comparative study, it is based on primary as well as secondary data. Primary data has been collected from interaction and interviews of the management of these CBOs and secondary data has been collected from various progress reports of these CBOs and various district departments like education and health. Target areas and population are Nowshera Kalan and Aman Garh in District Nowshera. Then the results obtained from Nowshera Kalan is compared with the data from Aman Garh using bar charts to evolve the effect of CBOs on community development. The time span consists of three years from August 2010 to July 2013.

4 FINDINGS AND DISCUSSION

Nowshera Kalan consists of different localities as the most populous region of district Nowshera. Almost each locality has formed their CBOs to address different problems facing that particular locality. CBOs working in Nowshera Kalan which are selected for the study, having area of specialization are : Fatima Welfare Foundation has core competencies in mother- child healthcare while Shah Hussaini Welfare society is providing vocational training like carpenter, tailoring and masonry etc to their respective community. Aba Khel Welfare Organization is working in infrastructure and WATSAN. Grana Khoor Women Society mission is to educate the most vulnerable and neglected segment of community specially women and children through non formal education system. A Honarmand Nokhaar program provides skill development related training such as farming and handicrafts etc. to enhance capacity and resilience of the community. Khegara Welfare Society is working for

awareness rising, poverty alleviation and disaster risk reduction through certain projects and programs like provision of livelihood support in terms of money and resources and through workshops. Nowkhaar Youth Society has been working since its inception in WATSAN and infrastructure maintenance damaged by the floods.

4.1 BASIC HEALTH FACILITIES

After 2010 floods, different diseases like itching, diarrhea and motion caused havoc in Nowshera Kalan. DHQ Nowshera was not sufficient to tackle the situation. So different

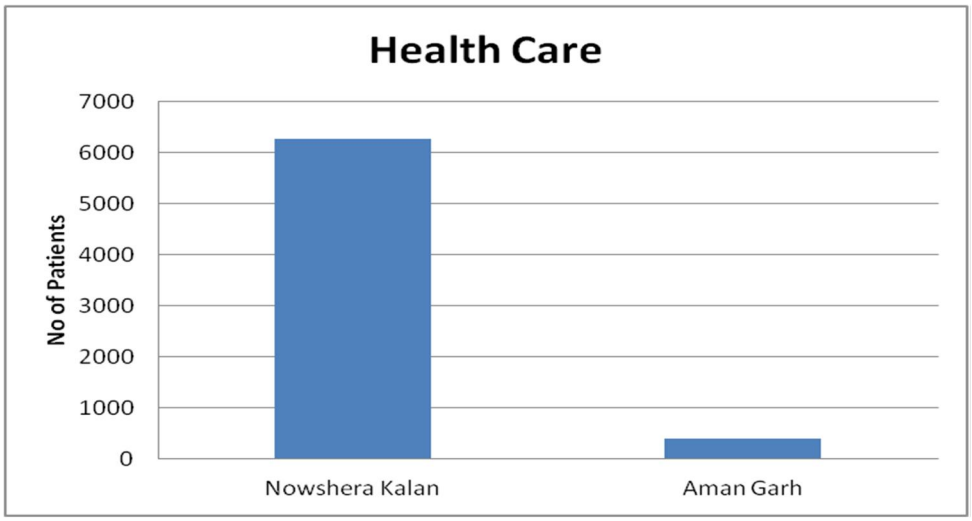

Fig. 2. Health care facilities in Nowshera Kalan and Aman Garh

CBOs working on health were funded by major donors like Medicine Sans Frontier (MSF) and WHO. 6266 patients including children got treatment through these CBOs. In comparison, in Aman Gargh, 394 people got treatment due to non availability of CBOs from District Headquarter (DHQ) Nowshera.

4.2 SUSTAINABLE LIVELIHOOD DEVELOPMENT

Active participation by the donors, CBOs provided skill development related training like tailoring, carpenter, vocational training to women and girls, wielding etc. to the youth and bread earners. Total of 2540 participants including female got training in Nowshera Kalan, while in Aman Garh only 287 youths including female got training due to non existence of CBOs.

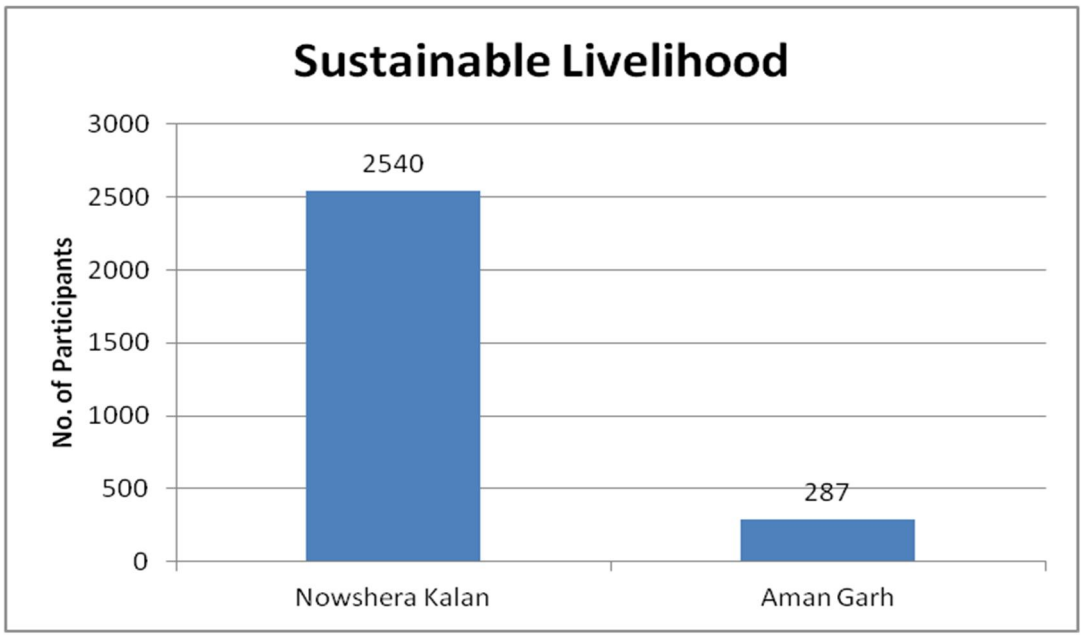

Fig. 3. Livelihood development outcomes in Nowshera Kalan and Aman Garh

4.3 EDUCATION

Data obtained from District Education department reveals that enrolment in primary schools increased in Nowshera Kalan both in male and female. The number of students enrolled during the study period are 3511 while in Aman Garh only 595 kids enrolled in schools. This difference is due to hectic and concerted efforts of CBOs in Nowshera Kalan.

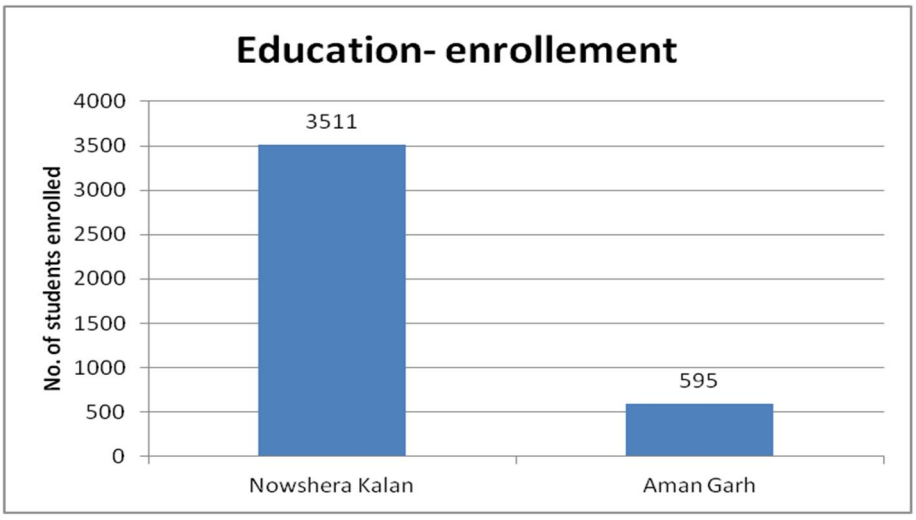

Fig. 4. Enrollment in schools in Nowshera Kalan and Aman Garh

4.4 WATSAN AND INFRASTRUCTURE

CBOs working in infrastructure and WATSAN have performed tremendously with the help of German Development Department (GIZ). Sewerage system of about 2 km have been repaired and some 150 hand pumps have been installed in Nowshera Kalan. While 80 toilets have been constructed. While in Aman Gargh, local NGOs constructed only 11 toilets and 7 hand pumps.

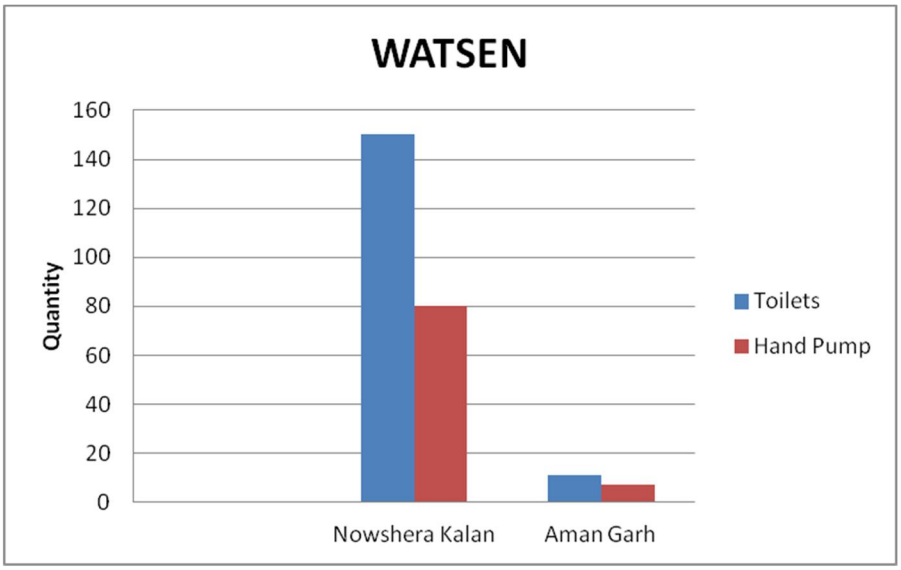

Fig. 5. Comparison of WATSAN provided in Nowshera Kalan and Aman Garh

5 CONCLUSION

From the findings of this study, it is revealed that with the community participation and empowerment and provision of funds and technical knowledge, the community has the capacity to sort out their problems and amicably solve it. The study also revealed that there is strong relationship between community based organizations and community development. It will be only effective when these CBOs are truly representative and do not serve only vested interests of the powerful and influential. These should be provided funds for its projects and recurring costs. By excluding the poor from CBOs and decision making, they will prove to be problem creator rather problem solver.

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Fingernails are the Best Indicator Sample for Biomonitoring

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ABSTRACT: To find out the best indicator sample for biomonitoring, whole-blood, urine, scalp hair, fingernail and tooth samples were collected randomly from volunteers of Mysore city and surrounding villages. These subjects (rural or urban) were grouped into two subgroups depending upon their personal/lifestyle factors namely, sex, occupation, food habit, drinking water source, alcohol consumption, betel and nut chewing, sugar level, blood, insulin treatment, economic status and cooking utensils used. The concentrations of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn in whole blood, urine, scalp hair and fingernail were determined with the use of ICP-AES and levels of Cr, Cu, Fe, Ni, Pb and Zn were measured in tooth samples with AAS. Mean element concentration for each subgroup in each sample was calculated and the difference in mean value between subgroups was tested for its significance. Significantly differing element levels in each sample shows the influence of personal factors; in other words each sample indicate the effect of various lifestyle factor. Overall comparison was made for suitability of samples for biomonitoring and it is concluded that the sum total number of varied elements in all the influencing factors were higher in fingernails and it reveals that the fingernails are ideal, suitable and recommended indicator sample for biological monitoring of element status among general, occupationally exposed and ill-health subjects.

KEYWORDS: Element concentration, lifestyle factors, subgroups, influence, comparison.

1 BACKGROUND

Biological monitoring of human occupational and environmental exposure to trace elements has been extended to include a number of human samples that are generally grouped under autopsy and biopsy samples. Many human autopsy samples such as endocrine glands, brain, bone, kidney, liver, lung, heart, stomach, spleen, muscle, thyroid, intestine, pancreas and ovary are extensively analysed for the concentrations of trace elements. Biopsy samples are of mainly two types such as non-invasive (tear, hair, urine, milk, saliva, sweat etc.) and invasive (blood, liver, teeth etc.) samples. Among them, non-invasive samples are predominantly used for element analysis. Among them mainly five bio-samples namely whole-blood, urine, scalp hair, fingernail and tooth were selected for the present study and it is very interesting to assess which is the best indicator sample for biomonitoring.

2 MATERIALS AND METHODS

2.1 SUBJECTS

The residents from Mysore city and surrounding villages who visited various hospitals in Mysore for consultation during the sampling period are the subjects. Based upon their places of residences from city and rural areas the subjects were

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mainly sorted out into rural and urban categories. Further, each category (rural or urban) was grouped into two subgroups depending upon their personal/lifestyle factors namely, sex, occupation, food habit, drinking water source, alcohol consumption, betel and nut chewing, sugar level, blood , insulin treatment, economic status and cooking utensils used (personal information were collected through questionnaire).

2.2 SAMPLING

Among the five biological samples (whole-blood, urine, scalp hair, fingernail and tooth) the permanent tooth samples (M=56 & F=60) were alone collected at JSS Dental College and Hospital, Mysore from one group of volunteers since tooth sampling is invasive in nature, painful with bleeding, time consuming and many subjects objected collection of other samples. Similarly, the other four samples, blood (M=100 & F=76), urine (M=68 & F=52), scalp hair (M=68 & F=52) and fingernail (M=68 & F=52) samples were collected from another group of subjects when visited to the Kamakshi Hospital, Bassappa Memorial Hospital and Vickram Hospital, Mysore (all the samples were collected with the approval of ethical committee). Further, the collected blood, urine, scalp hair and fingernail samples were not equal in number because some people refused to donate nail and hair samples in view of their orthodox nature and tradition.

2.3 PREPARATION OF SAMPLE FOR ELEMENT ANALYSIS

2.3.1 WASHING

Following standard procedures reported elsewhere [1] the tooth, scalp hair and fingernails were washed with double distilled water to completely remove loosely adhering external metals associated with fat, sweat and dirt without altering endogenous content of elements of the sample [2].

2.3.2 DRYING

After washing, these samples were dried in hot air oven at 50^{o} C and 3 hr time was required to achieve a constant weight indicating complete desiccation of the samples [3].

2.3.3 DIGESTION

Dried samples were wet acid digested with addition of HNO_3 and $HClO_4$ in 4:1 ratio in Kjeldhal digestive unit following the procedures reported by others [3]. Blood sample was digested as it is and urine was not digested since it is in liquid form. Simultaneously, few blank and quality control samples were digested for every 20 samples. Digested samples, blank and quality control samples were made up to 10 ml by adding DDW, stored in labelled, acid proof high density polyethylene bottles at 4^{o} C and were analysed for element levels within two weeks.

2.4 ELEMENT ANALYSIS

Concentrations of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn in whole blood, urine, scalp hair and fingernail samples were determined with the use of Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES), model JY-IYON-2002–2, at the Department of Environmental Engineering, Sri Jayachamarajendra College of Engineering, Mysore. Similarly, the levels of Cr, Cu, Fe, Ni, Pb and Zn were measured in tooth samples with Flame-Atomic Absorption Spectrometer (F-ASS) model - AAS 6 VARIO (make - Analytic jena), at Centre for Environmental Studies, Anna University, Chennai and School of Environmental Science, Jawaharlal Nehru University, New Delhi. Further, due to the non-availability of specific lamps, the amount of Cd, Co and Mn were not measured in tooth samples.

2.5 QUALITY CONTROL STUDIES

Considering the importance of precision and accuracy in element analysis the quality assurance in element analysis is taken care of by adopting 1) use of Certified Reference Material (CRM) – human hair powder as external quality control sample, 2) an in-house reference material as internal quality control sample and 3) participating in the inter laboratory quality control programme [4].

3 RESULTS AND DISCUSSION

Mean element concentration for each subgroup in each sample was calculated and the difference in mean value between subgroups was tested for its significance. Based on the fact that significantly differing element levels (between subgroups) in each sample shows the influence of personal factors or/in other words each sample may indicate the effect of various lifestyle factor, the influence of various personal characters on the levels of elements in different bio-samples (table 1) was discussed individually here under.

3.1 INFLUENCE OF PERSONAL CHARACTERS

3.1.1 GENDER

It is observed from the table 1 that the influence of gender on element levels were indicated in blood (Cr), urine (Ni and Pb), hair (Co, Cu and Zn) and teeth (Pb), but not in nail element levels. However, [5] observed that among the blood, urine, hair and nails samples gender affected only the blood element levels (Pb-B). On the other hand [6] reported that gender did not influence Se status in blood, urine and hair of Canadian subjects.

3.1.2 OCCUPATION

Occupation is related with the element levels in other words, influence of occupation on elements level were indicated in blood (Pb), hair (Cr, Mn and Ni) and nails (Co, Cu, Fe, Ni and Pb). It is observed that many elements' levels varied in nails due to occupation and that nails are good indicator of occupational exposure to elements. Several studies also reported that occupation alters element levels in blood [7], urine [8] and hair [9].

3.1.3 FOOD HABIT

Food habit of Mysore subjects altered their element contents in blood (Cd and Pb), nails (Cd, Cr, Mn and Zn) and teeth (Zn) whereas, urinary and hair element levels were not affected. In support, influence of diet was observed in blood and urinary element (Cd) levels in Japanese general population in Japan [10] and non-vegetarian hair, nails and urine of Japanese women subjects [11]. From the present study it is observed that nails may be a good indicator of diet causing change in the element levels.

3.1.4 SOURCES OF DRINKING WATER

Similarly, the drinking water influenced the element levels of blood (Ni, Co, Fe and Zn), urine (Cd, Cr and Pb) and hair (Co and Fe) and thereby indicating that blood, urine and hair may be used to monitor the influence of drinking water on body element levels (Ni, Co, Fe, Cd and Pb). There are studies stating the influence of drinking water on element levels in blood [12] urine [13].

Table 1. Showing the elements observed at significantly higher levels in the various samples (between subgroups)

SN	Personal Characters	Sub groups	Place	Elements in various samples				
				Blood	Urine	Scalp hair	Fingernails	Tooth
1	Gender	Male	Rural					
			Urban	Cr				Pb
		Female	Rural					
			Urban		Ni, Pb	Co, Cu, Zn		
2	Occupation	Non-industrial	Rural					
			Urban					
		Industrial	Rural					
			Urban	Pb		Cr, Mn, Ni	Co, Cu, Fe, Ni, Pb	

3	Food habit	Vegetarian	Rural					
			Urban				Cd, Cr, Mn, Zn	Zn
		Non vegetarian	Rural	Cd, Pb				
			Urban					
4	Drinking water source	Corporation water	Rural					
			Urban					
		Bore well water	Rural	Ni		Co, Fe		
			Urban	Co, Fe, Zn	Cd, Cr, Pb			
5	Alcohol consumption	Teetotallers	Rural					
			Urban	Cu				
		Alcohol taker	Rural		Co, Fe, Mn, Ni, Pb, Zn			
			Urban	Cr				
6	Smoking habit	Non smoker	Rural					
			Urban					
		Smoker	Rural	Cd, Co, Fe, Pb			Cd, Pb	
			Urban	Pb			Cd, Pb	
7	Betel & nut chewing	Non chewers	Rural			Mn		
			Urban					
		Chewers	Rural				Co	
			Urban					
8	Blood sugar level	Non diabetes	Rural					
			Urban				Zn	
		Diabetes	Rural	Cu		Co, Fe		
			Urban		Zn		Cd, Cr, Cu, Mn, Ni, Pb	Pb
9	Insulin treatment	NIDDs	Rural			Cu		
			Urban				Cr, Cu, Zn	
		IDDs	Rural					
			Urban	Pb			Co	
10	Blood pressure level	Normotensives	Rural					
			Urban			Co, Fe, Pb		Cu
		Hypertensives	Rural					
			Urban				Cu	Pb
11	Economic status	Low income	Rural				Co, Fe	
			Urban					
		Medium income	Rural					
			Urban					Pb
		High income	Rural					
			Urban		Mn	Fe		
12	Cooking utensils used	Stainless steel	Rural					
			Urban					
		Mixed	Rural					Cu
			Urban					

13	Environment	Rural				Co, Fe	
		Urban	Cd, Co, Fe		Ni, Pb	Pb	Cr, Fe, Ni, Pb, Zn

Note: The elements, which were significantly higher, were mentioned. Subgroups with reference to use of cooking utensils were observed only in tooth samples.

3.1.5 ALCOHOL CONSUMPTION

Consumption of alcohol is another personal habit influencing the element levels only in blood (Cu and Cr) and urine (Co, Fe, Mn, Ni, Pb and Zn) but not in other biological matrices. Many studies also reported influence of alcoholism on As-B and Pb-B [14] and urinary element levels [15]. Out of nine elements measured, the variations in six elements levels (Co, Fe, Mn, Ni, Pb and Zn) were observed in urine, which reflected that urine, may be the best suitable indicator for studying the influence of alcoholism on body element levels.

3.1.6 SMOKING

Smoking habit is associated with change in element levels of blood (Cd, Co, Fe and Pb) and nails (Cd and Pb) while, teeth, urine and hair element levels did not differ between non-smokers and smokers. It is noted that the differences in Pb levels were observed in all two samples (blood and nails), which may be used for biomonitoring of elements among smokers. In support, [5] reported that among the blood, urine, hair and nails samples analysed, smoking habit affected Pb levels only in blood and hair of Mansoura residents.

3.1.7 CHEWING OF BETEL AND NUT

The habit of chewing betel and nut showed limited variations in element levels of two samples particularly, Mn level in hair and Co in nails. In the case of other samples (blood, urine and teeth) the element levels did not differ. So these samples may have restricted use for biomonitoring of elements with reference to betel and nut chewing habit.

3.1.8 DIABETES

Diabetes changed the element levels in all the samples. However, single element only altered in blood (Cu), teeth (Pb) and urine (Zn) and two elements in hair (Co and Fe). But, in the case of nails the highest number of seven elements (Cd, Cr, Cu, Mn, Ni Pb and Zn) were altered, which may reflect that nails are an ideal indicator for biomonitoring of multi elements among diabetic patients. In support, other studies reported that the levels of Zn, Mn and Cr were affected in blood, urine and scalp hair of diabetics from Pakistan [16].

3.1.9 INSULIN TREATMENT

Insulin treatment changed only one element levels in both blood (Pb) and hair (Cu) and three elements in fingernails (Cu, Cr and Zn) and thus it is evident that nails may be the suitable indicator of insulin influence on element levels.

3.1.10 HYPERTENSION

Influence of hypertension on element levels in teeth (Pb) nails (Cu) and hair (Co, Fe, and Pb) was found, whereas no difference in element levels was observed in other samples. There are studies showing the influence of hypertension on hair element levels for Cu, Mn, Cr and Zn [17].

3.1.11 ECONOMIC STATUS

The economic status of the Mysorians is also a factor affecting the levels of Pb-T, Mn-U, Fe-H, Co-FN and Fe-FN, while it was not a factor for blood elements. However, [6] observed that educational level, as a social status did not alter Se content in blood, urine and hair of subjects from Canada. Since the studies reporting influence of economic status on element levels are meagre, further studies are required to confirm the influence of economic status on element levels.

3.1.12 USE OF COOKING UTENSILS

Tooth sample donors were grouped in to two subgroups namely mixed utensil and stainless steel (SS) utensil users, based on the use of type of metal utensils. But for other sample donors, all the subjects belong to only one category, i.e. SS utensil users. Hence, the difference in element levels was observed only in between the two subgroups of tooth sample donors and significantly higher level of Cu was found in mixed utensil users than stainless steel users. It is reasoned that repeated use of utensils may result in the bioaccumulation of Cu via food and assumed that tooth could be an indicator of bioaccumulation of Cu via food from cooking utensils.

3.1.13 INFLUENCE OF ENVIRONMENT

All the samples except urine indicated rural and urban gradients of the element levels. Variations of three elements in both blood (Cd, Co and Fe) and nails (Co, Fe and Pb) and two elements in hair (Ni and Pb) reflected the environmental influence. Further, out of six elements measured in teeth, five elements (Cr, Fe, Ni, Pb and Zn) differed in their concentrations due to environmental exposure gradients. Therefore, it is opined that the tooth samples may be the suitable indicator of environmental element exposure. In support, [5] reported that environment influenced Pb level in blood, urine, hair and nails of subjects from Egypt.

3.2 OVERALL COMPARISON TO FIND THE BEST SAMPLE FOR BIOMONITORING

The elements, which differed significantly between the subgroups in each sample of the present study, were denoted in '+' mark and the number of '+' marks of various samples were compared in the table 2. It is observed from the table that whole blood sample may be suitable for indicating the exposure of subjects to elements from drinking water, smoking and environment. Similarly, the urine sample may be the good indicator to study the element source from alcoholism, while scalp hair may be useful to study the elemental difference due to gender and hypertension. Out of thirteen influencing factors studied, nails showed the element differences in nine influencing factors. Among them the influences of dietary habit, occupation, diabetes and treatment with insulin were well demonstrated. In the case of teeth, influence of smoking and environment were alone reflected. Further, it appears that teeth are the best indicator for studying elemental exposure of human beings from environment and that the levels of elements measured in the permanent teeth indicate the accumulation of elements incorporated at the different time from tooth formation to development as well as the current status [17].

From overall comparison, it is observed from the table 2 that the total number of '+' mark i.e. the sum total number of varied elements in all the influencing factors were higher in fingernails (29+) and it reveals that the fingernails are ideal, suitable and recommended indicator sample for biological monitoring of element status among general, occupationally exposed and ill-health subjects. In comparison to other biological samples, there are many advantages in utilizing nails as a biomarker of toxic element exposure and nutritional mineral status [18]. These include (1) the ease with which nails can be sampled, stored, transported, and handled [19]; (2) standardized methods are available for collection, washing, preparation, and sophisticated instrumental analysis with use of quality control samples for precision and accuracy [20]; (3) storage of aliquots of sample is simple for reanalysis; (4) once elements are incorporated into keratin of nails, levels remain isolated from other metabolic activities in the body with no fluctuation in element levels due to changing body metabolic activities, unlike the blood.

Table 2. Overall comparisons for suitability of samples for biomonitoring

SN	Influencing factors	Whole blood	Urine	Scalp hair	Fingernails	Tooth	Inference / Remark
1	Gender	+	+ +	+ + +		+	Scalp hair may be the suitable indicator for gender influence.
2	Food habit	+ +			+ + + +	+	Fingernails may be the indicator to study the influence of dietary habit.

3	Drinking water source	+ + + +	+ + +	+ +			Whole blood indicates the influence of drinking water.
4	Occupation	+		+ + +	+ + + + +		Fingernails may be an ideal indicator of occupational exposure.
5	Alcohol consumption	+ +	+ + + + + +				Urine is a good matrix to indicate influence of alcoholism.
6	Smoking habit	+ + + +			+ +		Whole blood is a suitable indicator of smoking influence.
7	Betel & nut chewing habit			+	+		Further study required to understand clearly.
8	Blood sugar level	+	+	+ +	+ + + + + + +	+	Fingernails may be the most suitable indicator to study the influence of diabetes.
9	Blood pressure level			+ + +	+	+ +	Scalp hair may be considered for biomonitoring among hypertensives.
10	Economic status		+	+	+ +	+	Further study required to ascertain the influence of economic status.
11	Insulin treatment	+		+	+ + ++		Fingernails may be used for studying the influence of insulin impact.
12	Cooking utensils used					+	Further study required to confirm the influence of cooking utensils
13	Environment	+ + +		+ +	+ + +	+ + + + +	Teeth can be the ideal indicator for environmental exposure.
	TOTAL '+'	**19**	**13**	**18**	**29**	**12**	Fingernails may be the best biomarker for biomonitoring among general populations.

Note; '+' mark is to indicate the element levels observed significantly different in the sample for the factors.

4 CONCLUSIONS

As the total number of varied elements in all the influencing factors was higher in fingernails (29+), it may be concluded that the fingernails are ideal, suitable and recommended indicator sample for biological monitoring of element status among general, occupationally exposed and ill-health subjects. Further, it is suggested that the biosample use for assessment of human exposure to elements could be adopted in the following order of preference, fingernail, whole blood, scalp hair, urine and teeth.

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Intestinal Helminthic Infection in Numan (Northeast Nigeria)

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ABSTRACT: Intestinal helminthes are the most common diseases in Sub-Saharan Africa with a very higher negative public health and socio-economic impacts. Mass drug administration is one programme aimed at controlling the disease. The exercise has not been successful in Nigeria due to low levels of living standards, poor environmental sanitation, and ignorance of simple health-promoting behaviours. Due to negative impacts of helmithiasis, there is therefore the need for good preventive and control measures. This can not be done effectively without a baseline data on the occurrence of helminthiasis in a particular area. A study of prevalence of intestinal helminthes infections among inhabitants of five villages in Numan local Government area Adamawa, Nigeria was carried out using formal-ether concentration method. Out of the 296 subjects examined, 27(9.1%) were found to be infected with at least one helminth. The prevalence of intestinal helminthes found were Taenia spp (3.7%), Hookworm (3.4%), and *Ascaris lumbricoides* (2.0%). There was no significant association between helminthic infection and sex (P>0.05). There was no significant association between prevalence and age (P>0.05). Teania spp had the highest prevalence among subjects examined. Prevalence and co- infection was highest in Salti village. Intestinal helminthes are of public health importance in the area, and control measures are imperative.

KEYWORDS: Intestinal helminthes, Prevalence, Numan, *Ascaris lumbricoides*, Hookworm, Taenia spp.

1 INTRODUCTION

Helminthes are the most common parasitic agents of man in developing countries, and produce diseases with a very higher negative public health and socio-economic impacts.The two major phyla of helminthes known to infect man include the nematodes (roundworms) including major intestinal helminthes and filarial worms; and the platyhelminths (flatworms) include the trematodes, such as the schistosomes and the tapeworms. It is estimated that approximately one-third of the almost three billion people that live on less than two $ dollars per day in developing regions of Sub-Saharan Africa, Asia, and the Americas are infected with one or more helminth [1]. The most common helminthiasis is those caused by infection with *Ascaris lumbricoides, Trichuris trichuria* and hookworm, followed by schistosomiasis and lymphatic filariasis.

The inhabitants of rural impoverished villages throughout the tropics and subtropics are often chronically infected with several different species of helminthes. Most of these infections if left untreated may result in chronic disorders with both concurrent and delayed pathology to the infected human host. Approximately 300 million people with heavy helminthic infections suffer from severe morbidity that results in more than 150,000 deaths annually [2]. In addition to their health

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implications, helminthic infections also impair physical and mental growth in childhood and adolescents, thwart cognitive development, and hinder economic development.

In Nigeria, intestinal helminthes infections have continued to prevail because of low levels of living standards, poor environmental sanitation, and ignorance of simple health-promoting behaviours [3]. In view of the negative socio-economic impact of helminthiasis, there is therefore the need for the development of good preventive and control measures. This cannot be done effectively without a baseline data on the occurrence of helminthiasis in a particular area. The study was aimed at assessing the prevalence of intestinal helminthes infections in five villages of Numan local Government area of Adamawa, Nigeria.

2 MATERIALS AND METHODS

2.1 STUDY AREA

The study was conducted in Salti, Nzumosu, Gbalapun, Byenti and Kodomti villages of Numan local Government area in Adamawa state, Northeastern Nigeria. The state lies between latitude 7^0 and 11^0 N of the equator and between longitude 11^0 and 14^0 east of the Greenwich meridian. The state is traversed by river Benue, river Gongola and river Yadzaran. The mean annual rainfall is 759mm in the north to 1101mm in the south, August and September mark the peak of the rainfall. The average minimum and maximum temperature are 25^0C and 40^0C respectively. Occupation of the inhabitants includes farming, fishing and poultry and livestock keeping.

2.2 STOOL SAMPLE COLLECTION

Labeled wide-mouthed plastic containers were given out to the randomly selected subjects and were instructed on how to obtain their stool samples without contamination. The specimen containers were collected the following morning from the subjects and the stool samples were immediately preserved with 10% formalin and taken to the laboratory for analysis.

2.3 LABORATORY EXAMINATION OF STOOL SAMPLES

The stool samples were examined for the presence of helminthes using formal-ether concentration technique as described by [4]. One gram of stool was suspended in 10ml of 10% formaldehyde solution and mixed with applicator stick. The suspension was then passed through a funnel covered with a gauge, to remove debris into a bigger tube. 3ml of ether was added into the tube and capped. The suspension was then shaken to get a thorough mixture. The mixture was then transferred into centrifuge tube and centrifuge for 3 minutes at 4000rpm. An applicator stick was used to unplug the characteristic layer in the centrifuge tube, and the tube was inverted quickly and carefully to dispose the content living the sediments. The sediments were then examined by putting a drop on clean grease free glass slide, covered with cover slip under a microscope using 10x and 40x objectives for the presence of parasites.

2.4 STATISTICAL ANALYSIS

The data obtained in the study were presented in tables expressed in percentage and analyzed with respect to age, sex, and villages. Chi- square was used to determine the significance of the differences in prevalence.

2.5 ETHICAL CONSIDERATION

The objective and method of the study were explained to the communities in a series of meetings with their community leaders and full informed consent was obtained.

3 RESULTS

A total of 296 subjects were recruited for the study of which 27(9.1%) were positive for at least one of the helminthes detected. Prevalence of helminthic infection in relation to age showed that subject within the age group <20 years of age had the highest prevalence (10.7%). This was followed by age group 20-39 years (9.7%), 40-69 years (7.7%) and age group ≥ 70 years had zero prevalence. However, the prevalence of helminthic infection in relation to age shows no significant difference (x^2 =3.39; P> 0.05), but increases with increase in age (Table 1).

The prevalence of helminthes by age was higher in the males (10.1%) than in the females (8.2%) (Table2). There was however no significant difference in infection between males and females (x^2=0.610; P> 0.05).

Table 3 depicts the frequency of occurrence of Intestinal helminthes in 27 subjects with infection. A total of 32(10.8%) parasites belonging to three helminthes species were detected as *Ascaris lumbricoides*, Hookworm and Taenia spp. Prevalence of helminthes species found in positive stool samples shows that Taenia spp was the most predominant (3.7%). This was followed by Hookworm (3.4%), and *Ascaris lumbricoides* (2.0%) respectively.

Prevalence by villages as depicted in Table 3 shows that Salti village had the highest prevalence (24.0%), This is followed by Gbalapun (12.3%), Kodomti (8.3%), Nzumosu (6.7%), Byemti (4.9%) respectively. There was an overall prevalence of co-infection of 1.7% (n=5). The prevalence was highest in Salti (4.0%), and lowest in Gbalapun (1.5%). Prevalence of co infection was zero in Byemti village.

Table 1. Prevalence of intestinal helminthes infections by age

Age (years)	No. Examined	No. Infected	% Infected
<20	131	14	10.7
20-39	108	10	9.7
40-69	23	3	7.7
≥70	39	0	0.0
Total	296	27	9.1

Table 2. Prevalence of intestinal helminthes infections by sex

Sex	No. Examined	No. Infected	% Infected
Male	138	14	10.1
Female	158	13	8.2
Total	296	27	9.1

Table 3. Prevalence of intestinal helminthes infections by villages

Villages	No. exam.	A. inf. (%)	H. inf. (%)	T. inf. (%)	CI inf. (%)	To inf. (%)
Byemti	61	0(0.0)	3(4.9)	0(0.0)	0(0.0)	3(4.9)
Gbalapun	65	2(3.1)	2(3.1)	3(4.6)	1(1.5)	8(12.3)
Kodomti	60	0(0.0)	2(3.3)	2(3.3)	1(1.7)	5(8.3)
Nzumosu	60	0(0.0)	2(3.3)	1(1.7)	1(1.7)	4(6.7)
Salti	50	4(8.0)	1(2.0)	5(10.0)	2(4.0)	12(24.0)
Total	296	6(2.0)	10(3.4)	11(3.7)	5(1.7)	32(10.8)

Key: No. exam= number examined, Inf. = Infected, A= *Ascaris lumbricoides*, H= Hookworm, T= Taenia spp, CI= Co-infection, T= Total.

4 DISCUSSION

The prevalence of helminthes infections among different population is a function of environmental, parasitic, and host factors. This study revealed an overall prevalence of 9.1%. This is however higher than what was previously reported by [5] in Adamawa, who documented 43.0% prevalence value among students of post-primary institution. Our findings are also contrary to what was obtained by [6] who reported a prevalence of 33.3% in Adamawa.

Our findings are also contrary to what was obtained in other part of Northern Nigeria. Among such studies are those of [7], who documented a total prevalence of 43.2% in Agaie, Niger state, and [8] who recorded a total prevalence of 67.1% in Gwagwada, Kaduna. Finding of this study was however in consonance with the report of [9] in Edda South eastern Nigeria who documented a total prevalence of 10.7%.

There was no significant association in infection between sexes, male shows higher level of exposure to infection, than their female counterpart. This had corroborated the reports of [10] and [8]. This report was however contrary to the report of [11] and [12], (2009) who reported higher prevalence in females than in males.

In this study prevalence of intestinal helminthes infections by villages have shown that Salti village had the highest and lowest prevalence was recorded in Byemti village. Co-infection was also higher in Salti village, but the prevalence of co-infection was low compared to that reported by [7].Taenia spp are the predominant helminthes. This is attributable to the high consumption of pork meat in the area.

5 CONCLUSION

Taeniasis was very common among subjects of the five villages studied. Age and sex had no association with prevalence of helminthes infections. Prevalence rate decreases as the age of the subjects studied increases. Helminthic infections was still a public health issue in the area, therefore control measure is quite imperative. This can be achieved through sanitary disposal of feaces, proper sewage disposal to avoid contamination of source of drinking water from contaminated human sewage and thorough cooking of meat (beef and pork) and vegetables before consumption. This is because Taenia eggs are highly resistant and can withstand many months of environmental exposure over a broad temperature range.

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Analyse Econométrique de la Défaillance du Prêt Solidaire

[Econometric Analysis of the Failure in Group Lending]

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ABSTRACT: The joint liability presents a guarantee in group lending to Microfinance Institution. However this mechanism of lending is often accompanied by a strategic defect which generates failing micro-borrowers. The purpose of this study is to analyze in an econometric way this failure by using techniques of data analysis to study the validity and the efficiency of the group lending. To this end we shall use data from a foundation specialized in Microfinance, particularly in microcredit, it is a question in this study of the ARDI Foundation (Rabat – Morocco) for Microcredit. The handled database is constituted on one hand, by data collected from a field survey which targets the bad borrowers with regard to the number of days of delay of repayment, and on the other hand, data stemming from the information system of the foundation recapitulating the good borrowers. In this study we tried to establish characteristics of the borrowers, allowing to differentiate the vouchers of bad. The obtained results assert that the fundamental causes of the failure are, the absence of the mutual supervision and the mutual pressure, principles of the solidarity on which is based the microcredit. With the aim of minimizing the default risk we suggest favoring the groups of limited size, conceiving incentive contracts, as well as the application of a cross-reporting.

KEYWORDS: Microfinance, Microcredit, Joint laibility, Strategic default, Borrowers Classification.

RESUME: La responsabilité conjointe, présente une garantie dans les prêts solidaires chez les IMFs (Instituts de MicroFinance), cependant ce mécanisme de prêts est souvent accompagné par un défaut stratégique qui génère des micro-emprunteurs défaillants. Le but de cette étude est d'analyser d'une manière économétrique cette défaillance en utilisant des techniques d'analyse des données afin d'étudier la validité et l'efficacité des prêts solidaires. Pour ce faire on utilisera des données provenant d'un organisme spécialisé en MicroFinance, particulièrement en microcrédit, il s'agit dans cette étude de la Fondation ARDI pour le Microcrédit Rabat-MAROC, la base des données traitée est constituée d'une part, de données collectées à partir une enquête sur le terrain qui cible les mauvais emprunteurs relativement au nombre de jours de retard de remboursement, et d'autre part, des données issues du système d'information de la fondation récapitulant les bons emprunteurs. Dans cette étude nous avons cherché à établir des caractéristiques des emprunteurs, permettant de différencier les bons des mauvais. Les résultats obtenus affirment que les causes fondamentales de la défaillance sont, l'absence de la surveillance mutuelle et de la pression mutuelle, principes de la solidarité sur lesquelles est fondé le microcrédit. Dans le but de minimiser le risque de défaillance nous proposons de favoriser les groupes de taille limitée, concevoir des contrats incitatifs, ainsi que l'application d'un cross-reporting.

KEYWORDS: Microfinance, Microcrédit, Responsabilité conjointe, Défaut stratégique, Classification emprunteurs.

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1 INTRODUCTION

La micro-finance est une véritable industrie apparue dans les années 70 avec la création de la Grameen Bank fondée par Muhamud Yunus ''prix Noble de la paix en 2006''. Cette industrie, comporte le microcrédit, la micro-assurance, la micro-épargne et le transfert des fonds, elle se définit par l'offre de services financiers à la population pauvre. Elle s'adresse donc à des personnes à faible revenu, n'ayant pas accès aux établissements financiers classiques, et qui ne possèdent pas des activités salariales régulières mais ayant des capacités entrepreneuriales.

Son objectif est de répondre aux besoins des populations démunies et encourager les micro-entrepreneurs, à investir dans des projets générant des revenus, à l'aide d'un microcrédit.

Les produits offerts par l'IMF sont généralement de deux types, le prêt individuel et le prêt solidaire à responsabilité conjointe où chaque emprunteur déclare rembourser la (es) part(s) de ses partenaire(s) défaillant(s) ainsi la décision de remboursement dépend du groupe entier. Quant au prêt individuel la décision revient à l'emprunteur seul.

2 PRÉSENTATION DU PROBLÈME

Dans la référence [1], les auteurs analysent la stratégie défaut comme présence d'une forme d'asymétrie informationnelle. Ils expliquent que la défaillance n'est pas due à l'incapacité de rembourser mais à l'absence de volonté à rembourser le crédit.

Pour mieux gérer le risque lié au non remboursement, les IMFs s'appuient généralement sur deux approches fondamentales:

- Le prêt solidaire (collectif) basé sur la Coresponsabilité
- L'incitation/Sanction, basées sur l'accès au refinancement du micro projet.

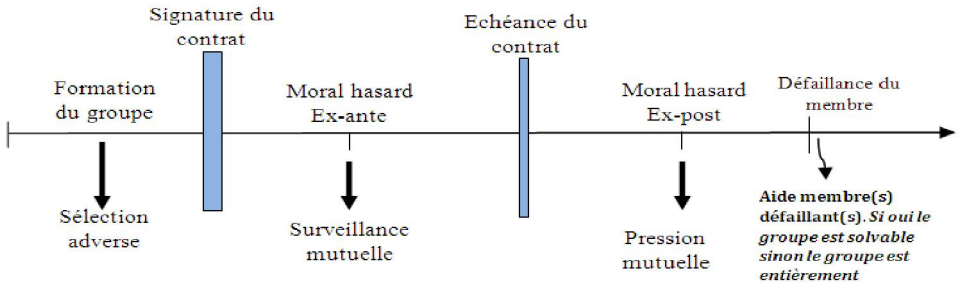

Fig. 1. Dynamique du contrat solidaire

Le prêt solidaire est considéré comme une garantie qui pourrait remplacer une garantie matérielle, le prêt individuel sera une récompense au client s'il a réussi ses remboursements. Plus que 70% des produits des IMFs portent sur le prêt solidaire, cependant souvent ce type de contrat est accompagné par le non-respect du remboursement après signature [1] et [2].

La figure 1 montre la dynamique du contrat de type prêt solidaire:

3 ANALYSE DES DONNÉES

Il s'agit d'une étude basée sur une enquête sur le terrain effectuée en 2011 où nous avons interrogé des clients défaillants qui ont un retard pour le remboursement supérieur à 180 jours.

Au Maroc, Depuis sa mise en œuvre dans les années 90 le secteur du microcrédit a connu un grand essor. 13 instituts de la MicroFinance (IMFs) dont la Fondation ARDI, plus de 793 633 clients actifs, avec un montant total en cours de plus de 528 millions $ (US) (source : Fédération Nationale des Associations de Microcrédit www.fnam.ma).

Les antennes visitées pour l'étude sont:

- Ain El Aouda, un petit village urbain de la région de Rabat-Salé-Zemmour-Zaer.
- Skhirat une commune urbaine de la région de Rabat-Salé-Zemmour-Zaer.
- Temara une commune urbaine de la région de Rabat-Salé-Zemmour-Zaer.

- Mechra Bel Ksiri une commune Urbaine de la région de Gharb-Chrarda-Beni Hsse
- Kariat Oulad Moussa, Salé, Région de Rabat-Salé-Zemmour-Zaer.
- Sidi Yahia el Gharb une commune Urbaine de la région de Gharb-Chrarda-Beni Hssen.

Parmi les 210 clients visités, nous avons réussi à interroger 143 individus dont les données complémentaires sont issues d'un système d'information de l'antenne.

Le questionnaire se focalise sur les variables suivantes :

- Les caractéristiques des clients : Age/ Sexe/ Situation Familiale/Nombre d'enfants/ Type d'activité.
- Les Caractéristiques du groupe : Taille du groupe, Homogénéité du group
- Le suivi du prêt : Surveillance et Pression mutuelle.

Pour une analyse objective de l'échantillon qui ne contient que les mauvais emprunteurs (défaillants), nous devons se référer à un autre échantillon issu du siège de la fondation, qui ne contient que les bons emprunteurs (solvables) pendant la même période et de la même zone. La comparaison entre les deux catégories permet de déterminer les caractéristiques de chacune.

La méthodologie d'analyse a été basée sur :

- La statistique descriptive, qui nous permet de résumer et de synthétiser l'information pour en tirer ses propriétés (moyenne, fréquence), mais aussi de suggérer des hypothèses relatives à la population choisie. Pour déceler les liaisons entre les différentes variables et la classe des emprunteurs (mauvais, bons), nous avons utilisé le test du khi-deux de contingence ($\chi 2$) et l'analyse de variance (F) à un facteur (ANOVA).
- La statistique analytique qui permet d'analyser les hypothèses utilisées. Cette étude confirme l'influence de certaines variables, précisément celles en liaison avec la défaillance. De l'échantillon choisi, nous avons tiré la structure générale des corrélations entre les variables. L'utilisation de l'ACP (Analyse en composante principale), et le calcul d'un indicateur appelé risque relatif (RR) nous ont permis de mesurer le degré de liaison entre certaines variables et la classe des emprunteurs.

4 RÉSULTATS ET INTERPRÉTATIONS

Les informations concernant les caractéristiques des emprunteurs mauvais et bons (solvabilité) sont regroupées dans le Tableau 1. D'après l'analyse de la collecte, l'âge et le nombre d'enfants, n'ont pas une influence significative ($p>0.001$).

La situation familiale, taille de groupe, type d'activité et type de la surveillance-pression sont principalement les variables qui différencient les mauvais emprunteurs des bons, ($p<0.001$).

Tableau 1. Distribution de l'échantillon en fonction de solvabilité des emprunteurs

Variables	Total	Les mauvais	Les bons	Test χ2 /F	*p*
Sexes					
Féminin	330	77	253	0,05	NS
Masculin	283	66	227		
Situation Familiale					
Marié	380	50	330	282,4	<0,001
Divorcé	15	3	12		
Célibataire	130	4	126		
Inconnu	98	86	12		
Taille de groupe					
2	10	-	10	22,5	<0,001
3	517	106	411		
4	81	28	53		
5	15	9	6		
Type d'activité					
Arisant	147	39	108	97,3	<0,001
Commerce	390	75	315		
Ouvrier	61	4	57		
Inconnu	25	25	-		
Homogénéité de groupe					
Hétérogène	246	52	194	1	NS
Homogénéité Fim.	215	54	161		
Homogénéité Mas.	162	37	125		
Moyen d'Age	39,3±11,5	37,9±11,5	38,5±11,5	0,2	0,6
Surveillance et pression mutuelle					
Absence	108	36	72	421,3	<0,001
Présence	420	12	408		
Inconnu	95	95	-		
Nombre d'enfants					
0	123	6	117	22,8	0,011
1	59	6	53		
2	81	7	74		
3	80	9	71		
4	37	10	27		
5	43	1	42		
6	23	4	19		
7	11	2	9		
8	6	0	6		
9	5	1	4		
10	3	0	3		
Inconnu	152	-	-		

Pour déceler le poids ou le risque relatif de chacune des variables nous avons effectué une analyse ACP et nous avons déduit pour chaque variable sa liaison avec la variable dépendante ''défaillance'' présentée dans figure 2, 3, 4, et 5. Il s'agit des variables explicatives : taille de groupe, situation familiale, type d'activité et surveillance-pression.

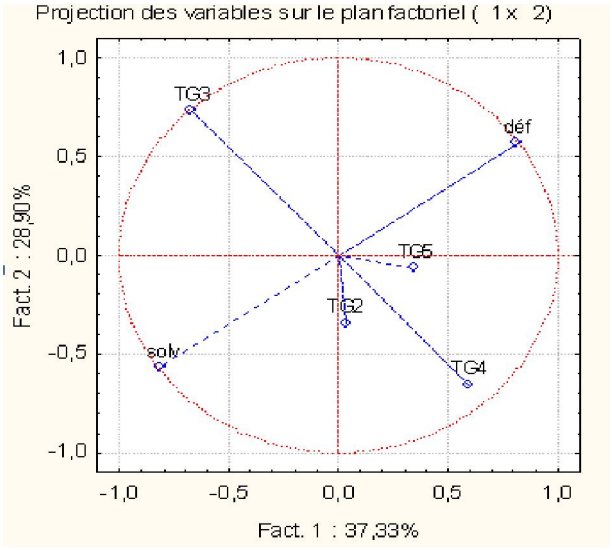

Fig. 2. ACP de Taille de groupe en fonction des variable ''défaillance et solvabilité''

- *déf: défaillance*
- *sol: solvable;*
- *TGn: groupe de n emprunteurs.*

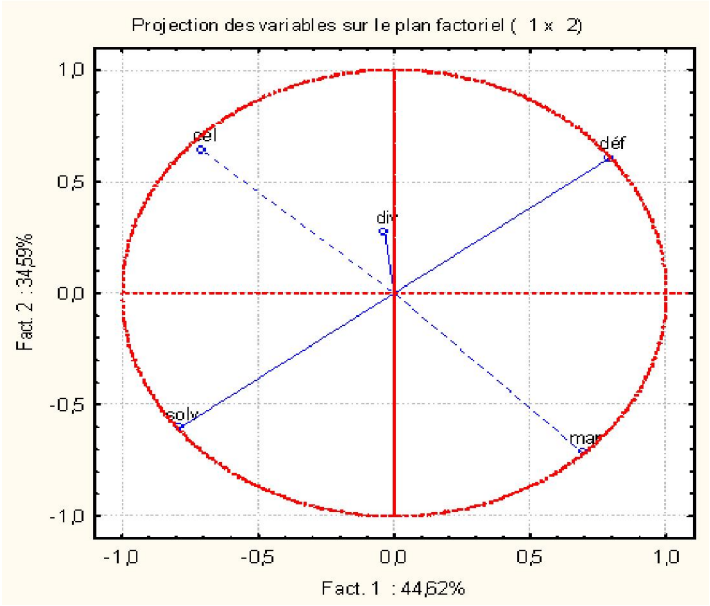

Fig. 3. ACP de Situation familiale en fonction des variable ''défaillance et solvabilité'

- *mar : marié ;*
- *cél : célibataire ;*
- *div : divorcé*

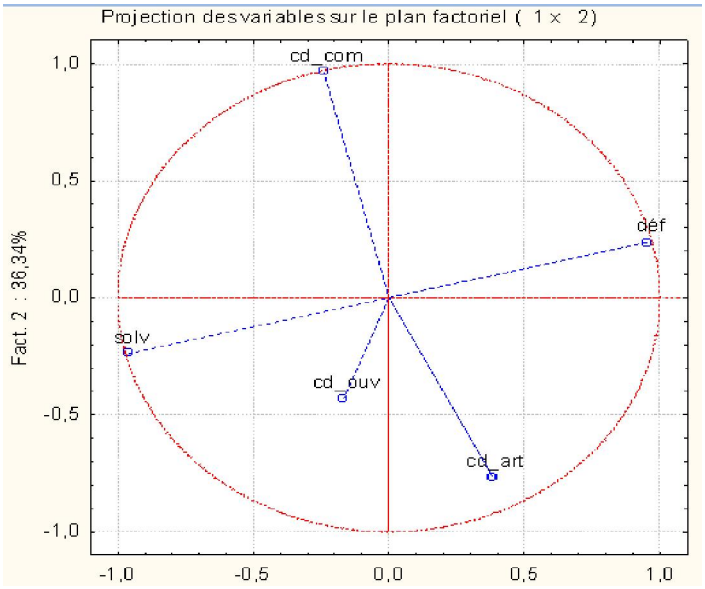

Fig. 4. ACP de Type d'activité en fonction des variable ''défaillance et solvabilité''

- *Cd_com : commerçant*
- *Cd_ouv :ouvier*
- *Cd_art :artisant*

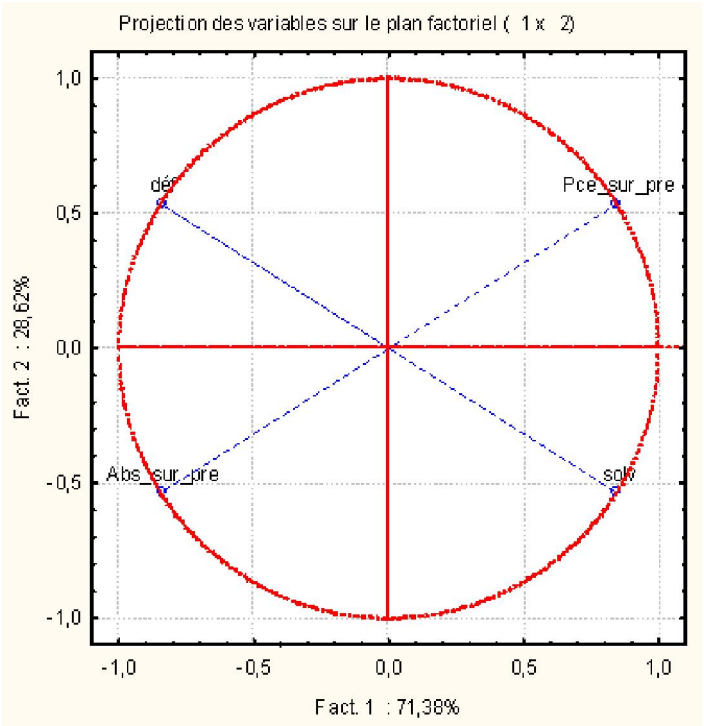

Fig. 5. ACP de Surveillance-pression en fonction des variable ''défaillance et solvabilité''

- *Abs/Pce_sur_pre : Absence/Présence de surveillance et pression mutuelles*

La figure 6 présente la structure générale de la corrélation entre toutes les variables et la variable ''défaillant'' et ''solvable''

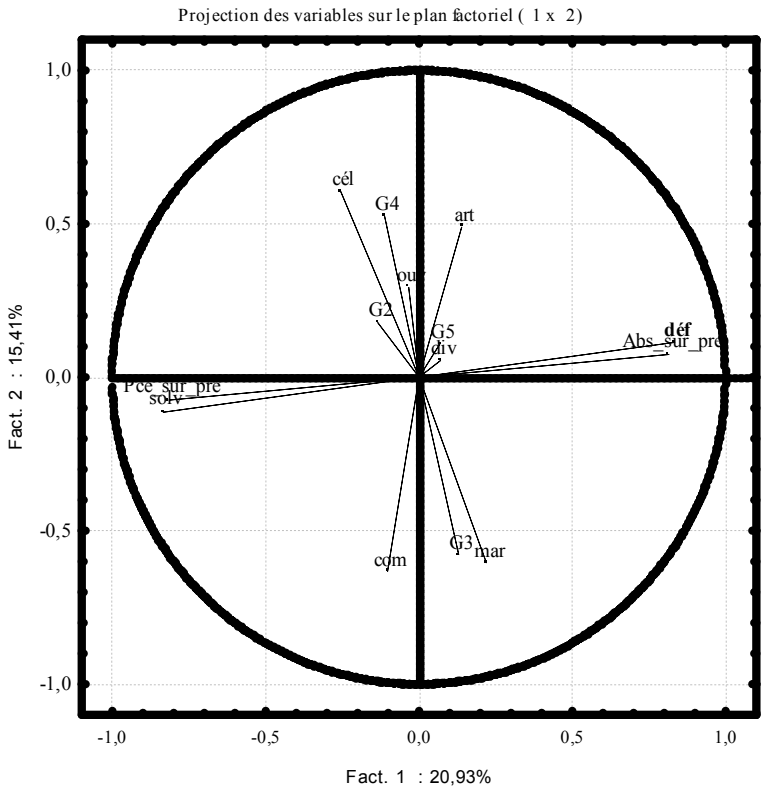

Fig. 6. ACP générale en function de ''défaillance et solvabilité''

Selon le *Tableau 2*, certaines variables significatives ou hautement significatives dans la partie descriptive, ont un risque relatif qui n'est pas nécessairement significatif, cela est dû à la fréquence des individus associés à ces variables.

Un groupe de 4 membres est risqué, avec un RR de 1.9, et celui de 5 (χ^2=11.9, p=0.002) est très risqué avec un RR de 5.3. Ainsi la défaillance croit en fonction de la taille du groupe.

Nous remarquons que la situation familiale : Marié, Divorcé et Célibataire (resp. le type d'activité : Artisan Ouvrier et commençant) sont des variables significatives. Marié (resp. Artisan) présente la composante la plus risquée. En effet (χ^2=7.5 et p=0.003) (resp. (χ^2=5.6 et p=0.01) et a pour RR 2.9 (resp. 1.7)

La troisième variable '' surveillance et pression'' qui est la variable la plus hautement significative (χ^2=96.5 et p=0.001), nous remarquons que la composante ''Absence de surveillance et pression'' présente un risque potentiel, RR associé est de 17.

Tableau 2. Les variables influençant la solvabilité des emprunteurs

Variables	Mauvais	Bons	Test χ2	p	RR	IC 95%
Taille du groupe						
2	0	10	3 ,2	0,07	1,3	1,2-1,3
3	106	411	10,3	0,001	0,4	0,3-0,7
4	28	53	7,1	0,007	1,9	1,1-3,2
5	9	6	11,9	0,002	5,3	1,8-15,1
Situation familiale						
Marié	50	330	7,5	0,003	2,9	1,3-6,7
Divorcé	3	12	1,3	0,2	2,1	0,5-7,7
Célibataire	4	126	10,8	<0,001	0,2	0,1-0,5
Type activité						
Ouvrier	4	57	7,4	0,003	0,2	0,1-0,7
Commerçant	75	315	0,1	0,3	0,9	0,6-1,3
Artisan	39	108	5,6	0,01	1,7	1,1-2,6
Surveillance et pression						
Présence	12	408	96,5	<0,001	17,0	8,4-34,2
Absence	36	72				

** IC 95% : Intervalle de confiance à 95% ; RR : Risque relatif*

5 DISCUSSION

L'objectif est de pouvoir protéger les bons emprunteurs des mauvais par l'empêchement du "défaut stratégique". Au vu des résultats obtenus par cette étude, nous constatons que pour assurer un contrat de prêt solidaire efficient, il est préférable que l'IMF:

- Favorise les groupes de taille très limitée, cela a été prouvé dans [3] où les auteurs recommandent d'emprunter à des groupes de taille minimale.
- Concevoir des mécanismes de prêts solidaires basés sur l'incitation, comme mentionné par [3] et [4].
- Appliquer un Cross-Reporting, pour renforcer la surveillance et la pression mutuelle comme dans [3] et [5]. Avec l'Incitation et le cross-reporting, chaque membre du groupe de prêt sera conscient de l'importance du prêt dans le refinancement de son microprojet. Pour qu'un bon emprunteur ait un refinancement, il devrait appliquer une surveillance et pression mutuelle dans le groupe de prêt, afin de révéler l'information et détecter les emprunteurs qui risquent d'être défaillants.

6 CONCLUSION

Un bilan synthétique de liaisons entre les variables montre que la cause fondamentale de la défaillance dans le prêt solidaire (nombre de jours de retard très élevé) dans cet échantillon, est que le principe de la solidarité n'a pas eu lieu. La défaillance de certains membres du groupe de prêt est due en premier lieu à l'absence de surveillance et de la pression mutuelle, et deuxièmement à la taille du groupe (4 et 5, membres). Finalement les données recueillies pendant l'enquête peuvent être exploitées pour d'autres types d'études et d'analyses, et permettre de dégager quelques pistes à explorer, à savoir, l'impact social des prêts sur le bienêtre du micro-emprunteur, financement de régions rurales en liaison avec les activités des villageois, les prêts solidaires et le rôle des Organisations Non Gouvernementales.

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Delay Reducing Design for 2- bit Reversible Comparator Unit

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ABSTRACT: On earth, communication between any organisms is in the form of analog signal. The manipulation of an analog signal is tedious; therefore analog to digital converter is used to convert the analog signal into digital form. Comparator plays a major role in the signal analysis. In addition to that, comparator circuit provides the efficient and high quality signal, among, the various input signals fed as an input. Magnitude comparator is a technique used to compare, the relation between given inputs in digital form that is in the form of 1's and 0's. Comparison between one or more input signals can be generated by using the relational operators. Comparison using conventional method is less immune to the noise; is a well-known aspect. Taking into an account, the reversible logic gates, which has zero loss of information is used to perform the comparison of two bit input data. In this paper, comparison is made between the two bit input data. The relative results such as A>B, A<B, A=B are provided for any 2 bit input combinations. The proposed reversible 2-bit comparator module effectively reduces the number of gates used, garbage values and the delay. The delay for reversible 2 bit comparator unit is 6.320 ns. The proposed architecture for the 2-bit reversible comparator using various reversible gates is provided with the output simulated using "ModelSim" and the synthesis report is generated using "Xilinx".

KEYWORDS: Comparator, Reversible logic, Reversible logic gate - M gate, Toffoli gate, MTG gate.

1 INTRODUCTION

In order to process any analog signal, convert the analog signal to digital signal. Analog to Digital convertor aids this conversion. The relation between any digital signals can be made by using the magnitude comparator. Comparator has its own major role in various fields such as railway communication to avoid rail crash, feed back circuitry to compare particular voltage signal in the field of communication, successive approximation techniques. The demerits of the conventional method can be eradicated on using the reversible logic gates. Reversible logic gates have the property of providing zero loss of information while performing any operation over digital signal. The major constraints of reversible logic gates are preventing fan-out and feedback. Taking into consideration, the benefefits of using the reversible logic gates; the comparision of 2-bit digital input data is performed using the reversible logic gates. Various reversible logic gates used for implementing the 2-bit reversible comparator are Toffoli gate, M gate and MTG gate. The relative output for the A>B, A<B, A=B is generated using the proposed architecture as shown in fig 4.

1.1 REVERSIBLE LOGIC

The reversible gates endow with one to one mapping among the input and output vectors; do not loose any information. The input and output are uniquely retrivable from each other. The reconstruction of the input data is made possible from the output and the garbage vectors at output state. The reversible logic gate effectively reduces the heat dissipation and hence the loss of information is nullified and thereby allows higher densities and high speed in the manipulation of an arithmetic operation. These gates reduce the complexity of implementation and works in a single clock pulse. The reversible logic Gates have zero fan-out and hence the power dissipation is also zero [1]. The reversible logic gates have garbage values along with the output terms. The number of inputs is equal to the sum of the number of outputs and the number of garbages.

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2 REVERSIBLE LOGIC GATE

The reversible logic gates used to implement the 2 bit comparator are Toffoli gate, M gate and MTG gate. The brief description about the reversible logic gates with their logic symbol are as follows:

2.1 TOFFOLI GATE

Toffoli gates have the property of 3*3 mapping with their input and output vectors [2]. The quantum cost of the Toffoli gate is 5.

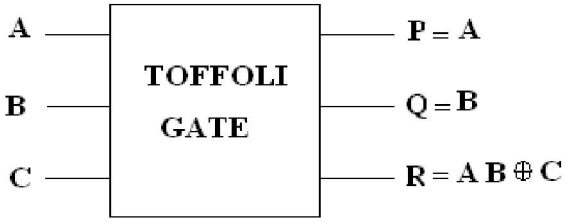

Fig. 1. Reversible logic Toffoli gate

2.2 M GATE

M gate is a 3*3 gate with 3 input and 3 output vectors [3]. The quantum cost is about 5.

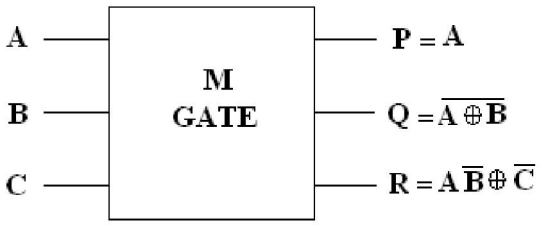

Fig. 2. Reversible logic M gate

2.3 MTG GATE

MTG gate is a 3*3 input-output mapping gate [4].

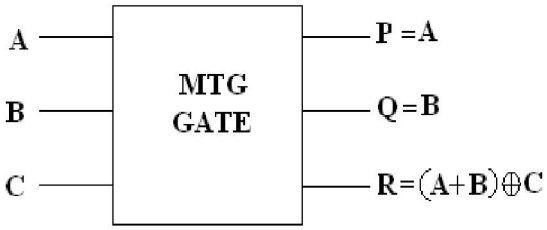

Fig. 3. Reversible logic MTG gate

3 COMPARATOR

Comparators are dedicated to perform the comparision of two voltages or signals. They provide high signal for A>B, A<B, A=B correspondingly at their respective output ports. Comparator produce the voltage 0 or 1 with respect to the input signal value is above threshold voltage or below threshold voltage. Comparator has a wide range of applications such as null

detector to dectect the zero signal value, zero crossing detector, relaxation oscillator, level shifter, Analog to digital Convertor, sotring network.

In this paper, the reversible logic gates like M gate, MTG gate and Toffoli gate are used to compare the 2-bit input data. The architecture used for implementing the reversible 2-bit comparator is shown in the fig.4. In this reversible logic implementation, four M gates, three Toffoli gate, two MTG gate were used.

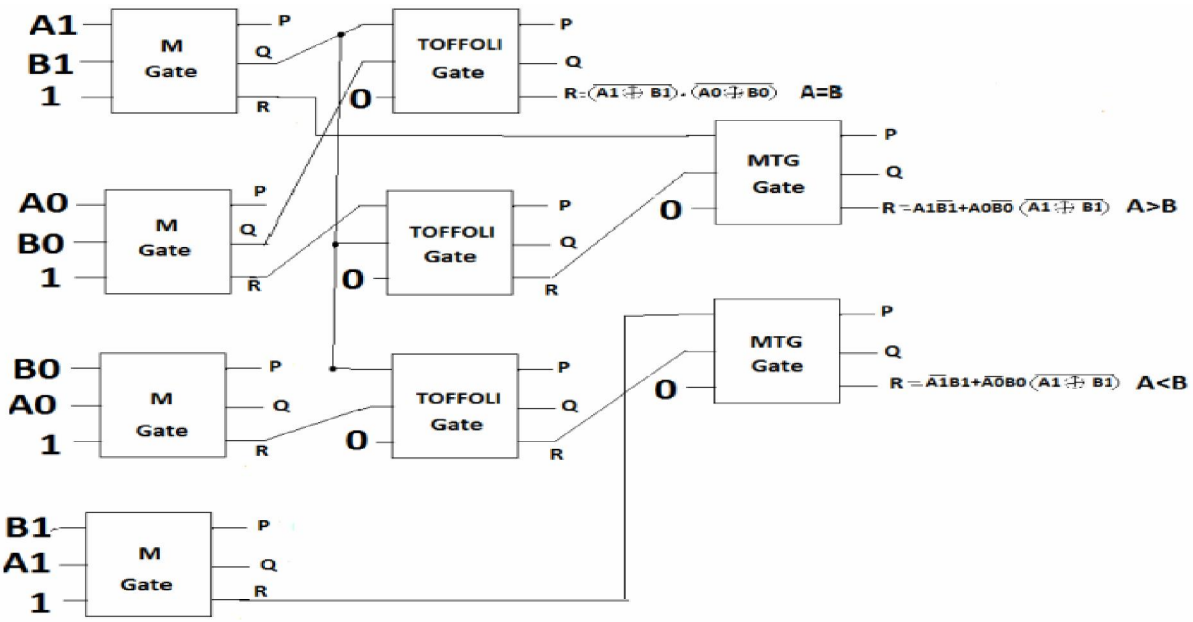

Fig. 4. Architecture for Reversible 2 bit Comparator unit

This architecture effectively reduces the number of use of the reversible logic gates. These nine reversible logic gates from fig. 4 were suffecient to implement the reversible 2 bit comparator unit. Four - M gate, 3 Toffoli gate and two MTG gates were used for this purpose of 2 bit reversible magnitude Comparator.

The input for this architecture is in the digital form such as 1's and 0's. So produced output after manipulation is either 1 or 0 on the corresponding output port. '1' specifies the true and the '0' specifies the false value.

CONDITION 1:

The value of A=B, the high value that is '1' is produced at the port correcponding to the A equal to B relational port and the other port will provide the output as low signal that is '0'. This indicates that the value of A and B are equal in magnitude. The logic expression is shown in the section 3.1.

CONDITION 2:

The value of A<B, the high value that is '1' is produced at the port correcponding to the A less than B relational port and the other port will provide the output as low signal that is '0'. This indicates that the value of A is less than B compartively, in magnitude. The logic expression is shown in the section 3.2.

CONDITION 3:

The value of A>B, the high value that is '1' is produced at the port correcponding to the A greater than B relational port and the other port will provide the output as low signal that is '0'. This indicates that the value of A is greater than B compartively, in magnitude. The logic expression is shown in the section 3.3.

3.1 A=B

In order to perform the relation between A equivalent to B, two M gate and one toffoli gate are needed. The logic expression to perform A=B is given by $\overline{(A1 \oplus B1)}.\overline{(A0 \oplus B0)}$ [5].

3.2 A>B

In order to perform the relation between A greater than B, two M gate, one Toffoli gate, one MTG gate are needed. The logic expression to perform A>B is given by $A1\overline{B1}+A0\overline{B0}\ \overline{(A1 \oplus B1)}$ [5].

3.3 A<B

In order to perform the relation between A less than B, two M gate, one Toffoli gate, one MTG gate are needed. The logic expression used to perform A<B is $\overline{A1}B1+\overline{A0}B0\ \overline{(A1 \oplus B1)}$ [5].

4 RESULT AND DISCUSSION

The result for the 2- bit comparator is simulated using the simulator called 'ModelSim' is shown in the fig.5.

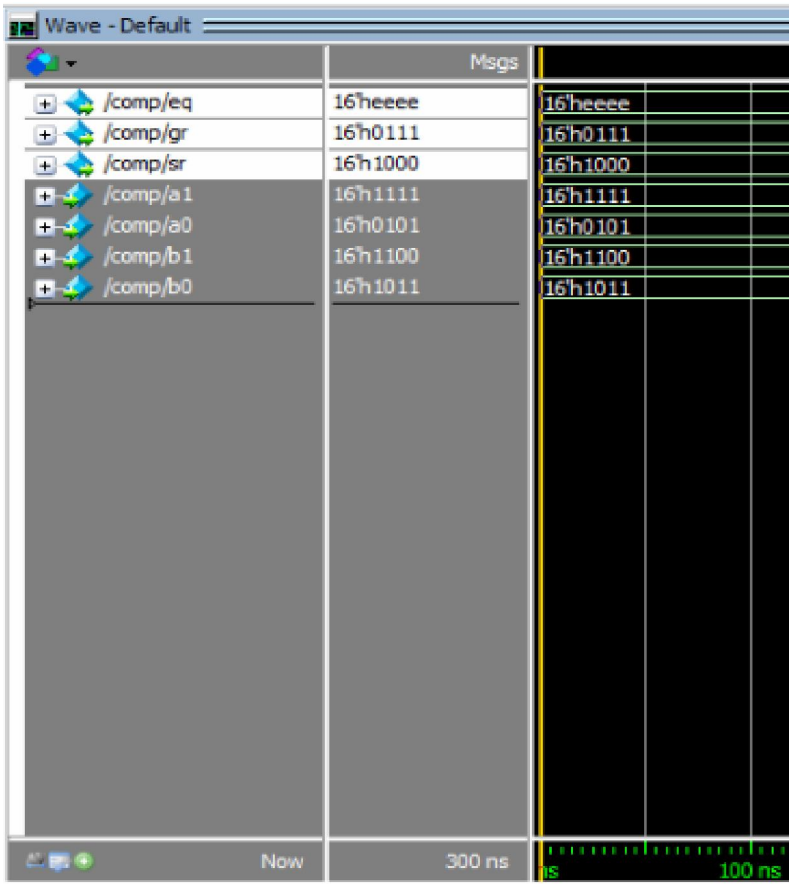

Fig. 5. Simulation Result for Reversible 2-bit Comparator

From the above result a1,a0,b1,b0 are the inputs where A is compared with B and the relative output for the input fed is produced as the high signal that is '1'; this is produced in case of the corresponding conditions become true. From the fig 5 port name eq is to display the comparative output if the 2 bit input data is equal. The port name sr provides the result if the value of A is smaller than B. The port gr gives the comparative result of if the value of A is greater than B.

The proposed architecture is implemented over the Spartan 3E kit in the Xilinx synthesizer to know the utilization factors and delay for comparing the 2 bit input data is shown in the table below.

Table 1. Simulation result for 2 bit reversible Comparator unit

Logic Utilization	Used	Available	Utilization
Number of slices	28	960	2%
Number of 4 input LUT	48	1920	2%
Number of bonded IOB's	112	66	169%

The delay calculated for performing the comparision of 2- bit input data is 6.320 ns, which is obtained from 'Xilinx' Synthesiser.

Table 2. Count for number of gates and gabage values for the reversible 2 bit comparator

Name of the gate	Toffoli gate	M gate	MTG gate
Number of gates used	16	32	24
Number of garbage output	48	48	32

From the architecture proposed in this paper, the reversible 2- bit comparator unit requires, the total number of reversible logic gates is 72 which includes sixteen - Toffoli gates, thirty two - M gate, twenty four – MTG gate. The garbage value used for the reversible 2 bit comparator unit is about hundred and twenty four.

5 CONCLUSION

The proposed reversible 2-bit comparator is very efficient when compared to the comparator performed using the transmission gates. On using the transmission gates the delay of processing the comparision operation is 1.038 ms [4]. On the other hand, the proposed reversible architecture can perform the same task of 2 bit comparision at about 6.320 ns. The reversible logic implementation, provide the zero loss of information hence it can be used widely for all the applications where the comparator plays a role. The proposed logic promises to reduce, the delay for comparing the 2 bit digital input data with reduced number of reversible logic gates and reduced garbage values than the conventional method of comparision.

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Étude théorique de la regiosélectivité et la stéreosélectivité de la condensation du β-himachalène avec le dichlorocarbène par la théorie de la fonctionnelle de la densité (DFT)

[Theoretical study of regioselectivity and stereoselectivity of condensation of β-himachalene with dichlorocarbene using density functional theory (DFT)]

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ABSTRACT: β-himachalene behaves as a nucleophile while dichlorocarbene behaves as an electrophile. Equimolar condensation of β-himachalene and dichlorocarbene results in a single product: (1S,3R,8R)-2,2-dichloro-3,7,7,10-tetramethyltricyclo[6,4,0,$0^{1.3}$]dodec-9-ene, also referred to as dichlorocarbene β-himachalene α (referred to as P_1 here), formed by reaction at the α side of the C_6=C_7 double bond of β-himachalene. This regioselectivity is controlled by the frontier orbitals, as is the reaction mechanism. Electron density is particularly high around the C_6=C_7 double bond of the HOMO orbital. However when β-himachalene reacts with two equivalents of dichlorocarbene under the same conditions the result is two products: (1S,3R,8R,9S,11R)-2,2,10,10-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane and (1S,3R,8R,9R,11S)-3,7,7,11-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane (referred to here as P_2 and P_3 respectively). The same two products are also obtained when P_1 reacts with one equivalent of dichlorocarbene. The attack takes place simultaneously at the α and β sides of the C_2=C_3 double bond. Study of the two reactions using the ab-initio quantum density functional theory method (B3LYP/6-31G(d)) shows that they are stereoselective, chemospecific, concerted and exothermic. P_3 is formed in greater quantity than P_2.

KEYWORDS: Chemical potential, chemospecificity, electrophil, exothermic reaction, frontier orbital, nucleophil, relative energy, transition state.

RESUME: Le β-himachalène se comporte comme nucléophile alors que le dichlorocarbène se comporte comme électrophile. Le β-himachalène réagit avec un équivalent de dichlorocarbène pour donner un seul produit: (1S,3R,8R)-2,2-dichloro-3,7,7,10-tetramethyltricyclo[6,4,0,$0^{1.3}$]dodec-9-ene (noté P_1), résultant de l'attaque de la double liaison C_6=C_7 du β-himachalène en face α. Cette régiosélectivité et le mécanisme réactionnel sont contrôlés par les orbitales frontières. La carte d'isodensité de l'orbitale moléculaire HOMO est très condensée au niveau de la double liaison C_6=C_7. Par contre le traitement du β-himachalène par deux équivalents de dichlorocarbène dans les mêmes conditions conduit à deux produits tétra-chlorés (1S,3R,8R,9S,11R)-2,2,10,10-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane et (1S,3R,8R,9R,11S)-3,7,7,11-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane (notés P_2 et P_3 respectivement). Ces deux produits sont également obtenus par l'attaque d'un équivalent de dichlorocarbène du produit P_1. L'attaque se fait simultanément en face α et β de la double liaison C_2=C_3. L'étude de ces deux réactions par la méthode

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quantique ab-initio théorie de la fonctionnelle de la densité B3LYP/6-31G(d) montre qu'elles sont stéréosélectives, chimiospécifiques, concertées et exothermiques. Le produit P_3 est majoritaire par rapport au P_2.

MOTS-CLEFS: Chimiospécificité, électrophile, énergie relative, état de transition, nucléophile, orbitale frontière, potentiel chimique, réaction exothermique.

1 INTRODUCTION

L'huile essentielle de cèdre de l'Atlas est constituée principalement (75٪) de trois hydrocarbures sesquiterpéniques bi-cycliques (l'α-himachalène, le β-himachalène et le γ-himachalène) [1]. Ces trois composés se transforment facilement en leurs isomères de jonction trans par action d'acide chlorhydrique gazeux suivie d'une déshydrochloration sur alumine basique [2] (Figure 1).

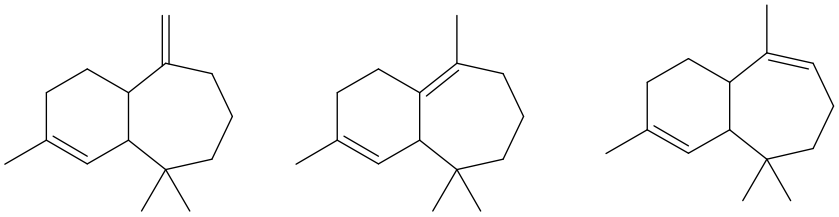

Fig. 1. Les isomères d'himachalène

L'action d'un équivalent de peracide au β-himachalène conduit chimio-spécifiquement à un seul composé mono-époxyde en position 6-7 de configuration α, tandis qu'un excès de peracide donne deux diastéréoisomères, la double liaison C_2=C_3 étant attaquée simultanément par les deux faces α et β [3].

Le résultat expérimental de la réaction entre un équivalent de β-himachalène et un équivalent de dichlorocarbène a été confirmé par une étude théorique (AM_1) [4].

Des études théoriques montrent que la mono-époxydation de α cis et α trans himachalène est hautement stéréo- et régiosélective, alors que leur diépoxydation est faiblement stéréosélective [5].

L'étude expérimentale de la réaction entre un équivalent de β-himachalène et un équivalent de dichlorocarbène conduit chimiospécifiquement à un seul produit P_1 **(**(1S,3R,8R)-2,2-dichloro-3,7,7,10-tetramethyltricyclo[6,4,0,$0^{1.3}$]dodec-9-ene) (Figure 2) [6], [7], [8]. La structure a été déterminée par les données spectrales (RMN, ^{1}H, ^{13}C et spectrométrie de masse) et la stéréochimie a été confirmée par la diffraction des rayons X [9]. L'action de deux équivalents de dichlorocarbène conduit à la formation de deux diastéréoisomères tétrachlorés, nommés P_2 ((1S,3R,8R,9S,11R)-2,2,10,10-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane) et P_3 ((1S,3R,8R,9R,11S)-3,7,7,11-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane) (Figure 2). Les structures de ces deux produits P_2 et P_3 ont été déterminées par les analyses spectrales (RMN, ^{1}H, ^{13}C et spectrométrie de masse) et par la diffraction des rayons X [9], [10].

Dans ce travail, nous nous sommes intéressés à l'étude de l'attaque du β-himachalène par le dichlorocarbène en utilisant la méthode quantique ab-initio DFT (théorie de la fonctionnelle de la densité) B3LYP/6-31G(d). L'utilisation de cette méthode contribue à la prédiction des distances interatomiques des produits obtenus, des énergies totales, des énergies relatives et des énergies de transition. À partir de ces résultats, nous pouvons déduire si l'attaque se fait à la face α ou β, ainsi que la nature du mécanisme réactionnel et confronter nos conclusions aux résultats expérimentaux disponibles.

2 CONCEPTS CHIMIQUES ET INDICES DE REACTIVITE DERIVANT DE LA DFT

2.1 INDICES GLOBAUX DERIVANT DE LA DFT CONCEPTUELLE

La théorie de la fonctionnelle de la densité (DFT) permet la détermination du potentiel chimique électronique, de l'électronégativité, de la dureté, de la mollesse, de l'électrophilicité, etc. La DFT est fondée sur le principe variationnel. En effet, l'énergie d'un système est une fonctionnelle de la densité électronique.

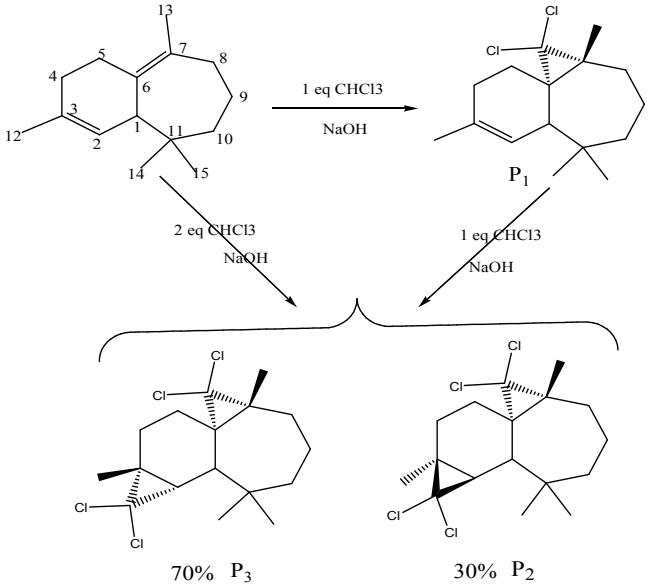

Fig. 2. Réaction de condensation entre le β-himachalène et le dichlorocarbène

2.1.1 POTENTIEL CHIMIQUE ÉLECTRONIQUE

Selon Parr [11] le multiplicateur de Lagrange peut être défini comme le potentiel chimique électronique μ.

$$\mu = \left(\frac{\partial \mathrm{E}}{\partial \mathrm{N}}\right)_{v(r)} = -\chi \tag{1}$$

2.1.2 DURETÉ GLOBALE ET MOLLESSE GLOBALE

L'expression fondamentale de la DFT correspondant à la variation de l'énergie d'un état stationnaire à un autre est donnée par :

$$dE = \mu dN + \int \rho(r)\delta v(r)dr \tag{2}$$

μ : potentiel chimique

$\rho(r)$: densité électronique

$v(r)$: potentiel externe du système

La première dérivée partielle de μ par rapport à N (le nombre total d'électrons) est définie comme la dureté (hardness) globale η du système [12] avec la quantité S étant la mollesse (softness) globale du système.

$$2\eta = \left(\frac{\partial \mu}{\partial \mathrm{N}}\right)_{v(r)} = \left(\frac{\partial^2 E}{\partial^2 \mathrm{N}}\right) = \frac{1}{S} \tag{3}$$

Le potentiel chimique électronique μ et la dureté globale η peuvent être calculés à partir des énergies des orbitales moléculaires frontières ε_{HOMO} et ε_{LUMO} comme suit:

$$\mu = \left(\frac{\varepsilon_{HOMO} + \varepsilon_{LUMO}}{2}\right) \tag{4}$$

$$\eta = \left(\varepsilon_{LUMO} - \varepsilon_{HOMO}\right) \tag{5}$$

2.1.3 INDICE D'ÉLECTROPHILIE GLOBALE

La question posée est ainsi de savoir combien un électrophile pouvait acquérir d'électrons, s'il était immergé dans une mer d'électrons libres. La valeur du nombre d'électrons acquis et la stabilisation énergétique qui en découlerait permettrait de comparer le pouvoir électrophile de deux espèces. Soit donc un électrophile, la variation de son énergie électronique lors d'un transfert de charge à potentiel externe constant peut s'écrire :

$$\Delta E = \mu^{\circ}\Delta N + \frac{1}{2}\eta\Delta N^2 \tag{6}$$

Le pouvoir électrophile est donc défini comme la stabilisation énergétique due au transfert de charge :

$$\omega = \frac{\mu^2}{2\eta} \tag{7}$$

2.1.4 INDICE DE NUCLÉOPHILIE GLOBALE

On note que l'indice de nucléophilie ne peut être définie par une procédure variationnelle, parce qu'il n'y a pas de stabilisation électronique moléculaire le long de la soustraction de la densité électronique d'une molécule. En absence d'un descripteur de nucléophile, Domingo et al. [13] ont proposé que l'hypothèse selon laquelle une molécule faiblement électrophile est systématiquement fortement nucléophile ne soit vrai que pour des molécules simples.

Aux valeurs élevées de nucléophilie correspondent des valeurs faibles de potentiel d'ionisation et inversement. Domingo et al. ont utilisé les énergies HOMO obtenus par la méthode de Kohn-Sham. L'indice de nucléophilie (N) empirique (relatif) est défini comme suit [14]:

$$N = (\varepsilon_{HOMO(Nu)} - \varepsilon_{HOMO(TCE)}) \tag{8}$$

2.2 INDICES LOCAUX DE REACTIVITE DERIVANT DE LA DFT CONCEPTUELLE

Pour déterminer les sites réactifs d'une molécule lors de l'approche d'un agent électrophile, nucléophile ou radicalaire, les chimistes utilisent les charges nettes pour favoriser une interaction par rapport à une autre. Cependant, il est bien connu que le calcul des charges nettes sur les différents sites d'une molécule ne permet pas de bien décrire les interactions entre molécules, notamment dans le cas des réactions contrôlées par les orbitales frontières. En effet, la prédiction de la réactivité à l'aide des charges nettes peut conduire à des prédictions contradictoires avec l'expérience [15], [16]. Les études récentes [17], [18], [19] ont montré l'utilité d'appliquer le principe HSAB dans un sens local pour l'étude des interactions entre molécules.

3 MÉTHODOLOGIE INFORMATIQUE

Tous les calculs présentés ici ont été exécutés en utilisant Gaussian 09 [20] pour optimiser les géométries et calculer les énergies correspondantes pour les réactifs, et pour déterminer les structures d'état de transition. La nature des états de transition a été confirmée par la présence d'une seule fréquence imaginaire dans la matrice hessienne. Les produits ont été déterminés par la méthode DFT [21], [22] avec les ensembles de base 6-31G(d) [23], [24], en utilisant l'algorithme de Berny [25].

Les populations électroniques atomiques et les indices de réactivité ont été calculés en utilisant les analyses de population naturelle (NPA) [26].

4 RÉSULTATS ET DISCUSSION

4.1 CONFORMERE LE PLUS STABLE DU B-HIMACHALENE

Avant d'entamer l'étude du mécanisme de la condensation de dichlorocarbène au β-himachalène, il est intéressant de faire une étude conformationnelle de β-himachalène.

Pour le β-himachalène, le nombre de conformères est relativement faible en raison de la double liaison C_6=C_7 qui fait intervenir un atome de carbone de la jonction entre les deux cycles. La double liaison C_2=C_3 impose aux atomes de carbone C_1, C_2, C_3, C_4, et C_{12} d'êtres coplanaires, de même la double liaison C_6=C_7 oblige les atomes C_1, C_5, C_6, C_7, C_8, et C_{13} d'être aussi dans un même plan. Dans la suite de notre étude, nous allons prendre le conformère le plus stable du β-himachalène dont la valeur d'énergie calculée par la méthode DFT au niveau B3LYP/6-31G(d) est de -365340.7234 (kcal/mol). La stabilité de ce conformère a été confirmée par la méthode AM1 [4]. Le conformère de β-himachalène le plus stable est représenté dans la Figure 3.

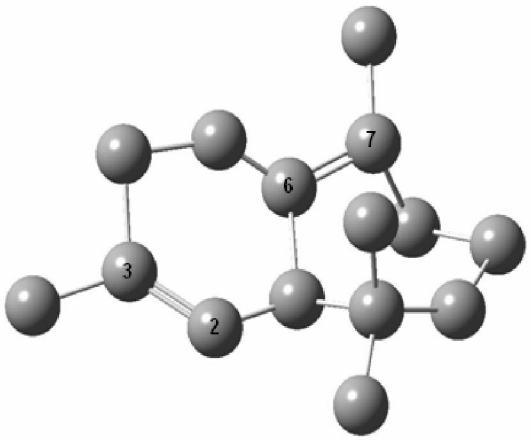

Fig. 3. Le conformère le plus stable du β-himachalène

Dans d'autres travaux, nous avons obtenus des propriétés chimico-physiques, telles que l'énergie vibrationnelle au point zéro, par les méthodes semi-empiriques [27], [28], [29].

4.2 REPRESENTATION DE LA CARTE D'ISODENSITE DU HOMO DE B-HIMACHALENE

La représentation de la carte d'isodensité de l'orbitale moléculaire HOMO du β-himachalène (Figure 4) montre que l'orbitale HOMO est très condensée au niveau de la double liaison C_6=C_7, ainsi l'attaque d'un équivalent de dichlorocarbène se fait en préférence au niveau de cette double liaison.

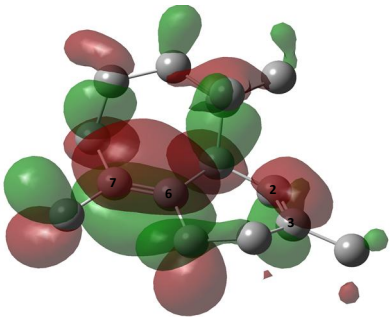

Fig. 4. Carte d'isodensité de l'orbitale HOMO du β-himachalène

4.3 PREMIÈRE CONDENSATION

4.3.1 CHIMIOSÉLECTIVITÉ

La réaction entre le β-himachalène et un équivalent de dichlorocarbène conduit à la formation d'un α mono-dichlorocarbène β-himachalène **(**(1S,3R,8R)-2,2-dichloro-3,7,7,10-tetramethyltricyclo[6,4,0,$0^{1.3}$]dodec-9-ene), résultant de l'attaque la double liaison C_6=C_7 en face α par le dichlorocarbène. Cette réaction est chimiospécifique et stéréospécifique. c'est-à-dire que le dichlorocarbène réagit avec la seule double liaison C_6=C_7.

4.3.2 PREDICTION DE LA NATURE DU MECANISME REACTIONNEL ET DU CARACTERE ELECTROPHILE/NUCLEOPHILE

Afin de mettre en évidence la nature du mécanisme réactionnel et le caractère électrophile/nucléophile des réactifs (β-himachalène et dichlorocarbène), nous avons calculé les énergies des orbitales moléculaires HOMO et LUMO de chaque réactif et les différences d'énergie ΔE_1 et ΔE_2 entre l'orbitale HOMO de l'un et l'orbitale LUMO de l'autre et vice versa, les potentiels chimiques électroniques μ, la dureté chimique η, les indices d'électrophilie globale ω et les indices de nucléophilie globale N (Tableau 1). Tous ces paramètres ont été calculés en ev. Ces quantités sont définies en paragraphe 2.

Tableau 1. Énergies HOMO et LUMO, potentiel chimique électronique, dureté, électrophilie, nucléophilie globale, du β-himachalène et du dichlorocarbène

	ε_{HOMO} (ev)	ε_{LUMO} (ev)	Potentiel chimique électronique μ (ev)	Dureté η (ev)	Électrophilie ω (ev)	Nucléophilie globale N (ev)
β-himachalène	-5,6925	0,6938	-2,4993	6,3864	0,4890	3,4274
Dichlorocarbène	-7,3578	-3,5510	-5,4544	3,8068	3,9075	1,7621

Le Tableau 1 montre que :

- Le potentiel chimique électronique du β-himachalène (-2,4993 ev) se trouve au niveau d'énergie supérieur à celui du dichlorocarbène (-5,45445 ev), ce qui implique que le transfert d'électrons a lieu du β-himachalène vers le dichlorocarbène.
- L'indice d'électrophilie du dipolarophile dichlorocarbène (3,9075 ev) est supérieur à celui du β-himachalène (0,4890 ev). Par conséquent, dans cette cycloaddition le dichlorocarbène se comporte comme électrophile alors que le β-himachalène se comporte comme nucléophile.
- La différence d'énergie entre les orbitales externes des réactifs: ε_{HOMO}(β-himachalène) - ε_{LUMO} (dichlorocarbène) ΔE_1= 2,1400 (ev) et ε_{HOMO} (dichlorocarbène) - ε_{LUMO} (β-himachalène) ΔE_2= 6,6640 (ev), ce qui montre que cette réaction est contrôlée par les orbitales frontières.

4.3.3 STÉRÉOSÉLECTIVITÉ

Pour démontrer que l'attaque de la double liaison C_6=C_7 du β-himachalène est préférée, nous avons déterminé les énergies des réactifs, les énergies des produits obtenus, les énergies relatives et les énergies TS_α et TS_β, la différence d'énergie de transition et le rapport K_α/K_β (Tableau 2).

Tableau 2. Les énergies totales B3LYP/6-31G(d) (E) et les énergies relatives ΔE pour les points stationnaires de la réaction équimolaire entre β-himachalène et dichlorocarbène*

	E (u.a.)	ΔE*(Kcal/mol)	$\Delta(TS_\beta - TS_\alpha)$ Kcal/mol)	K_α/K_β
β-himachalène	-586,0301		142,8315	≈ 10100
Dichlorocarbène	-958,383			
TS_β	-1544,1010	195,8427		
TS_α	-1544,3286	53,0112		
Produit α	-1544,5094	-60,4282		
Produit β	-1544,4848	-44,4897		

La surface de l'énergie potentielle correspond aux modes d'attaques en face α et β de la réaction entre β-himachalène et dichlorocarbène (Figure 5).

La Figure 5 montre que :

- L'écart entre TS_α (énergie de transition en face α) et TS_β (énergie de transition en face β) est de 0,2276 u.a., ce qui correspond à 142,819 Kcal/mol; les énergies d'activation correspondant aux deux faces d'attaque sont de 53,0112 Kcal/mol pour l'attaque en face α et 195,8427 Kcal/mol pour l'attaque en face β. Ceci indique que le stéréoisomère α est cinétiquement favorisé par rapport au stéréoisomère β.
- Les réactions en face α et β sont exothermiques par -60,4282 et -44,4897 Kcal/mol respectivement.
- Le grand écart d'énergie entre P_α et P_β montre que ces deux stéréoisomères ne sont pas iso-énergétiques.
- Le rapport $K_\alpha/K_\beta \approx 100^{100}$, ce qui montre que la formation du stéréoisomère β est cinétiquement impossible.

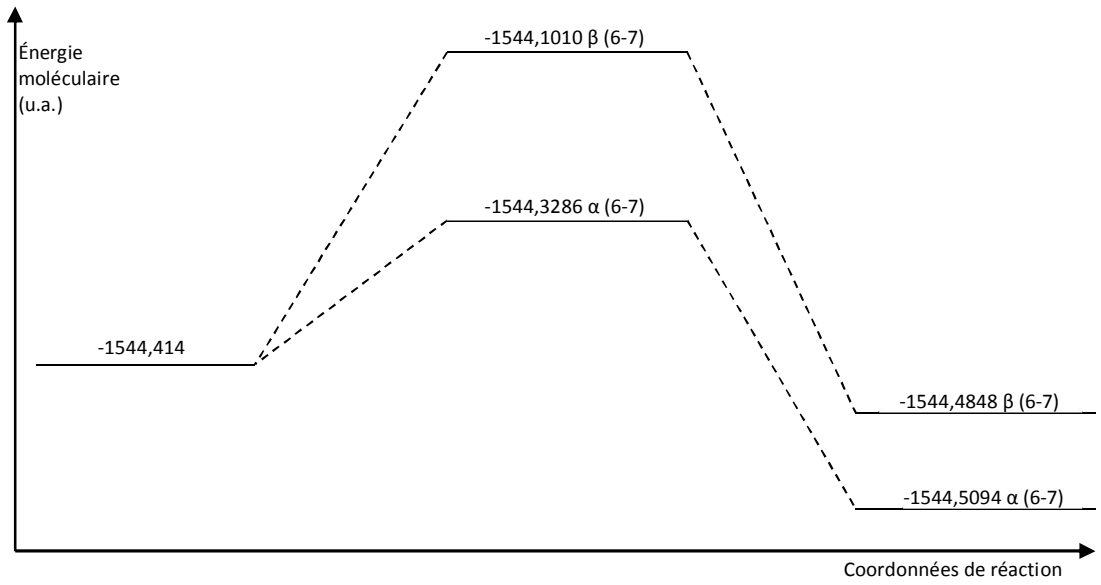

Fig. 5. Profil énergétique de la réaction équimolaire entre β-himachalène et dichlorocarbène

Afin de déterminer les distances interatomiques impliquées dans les réactions de cycloaddition entre β-himachalène et dichlorocarbène, nous avons représenté les structures des états de transitions des deux approches α et β (Figure 6).

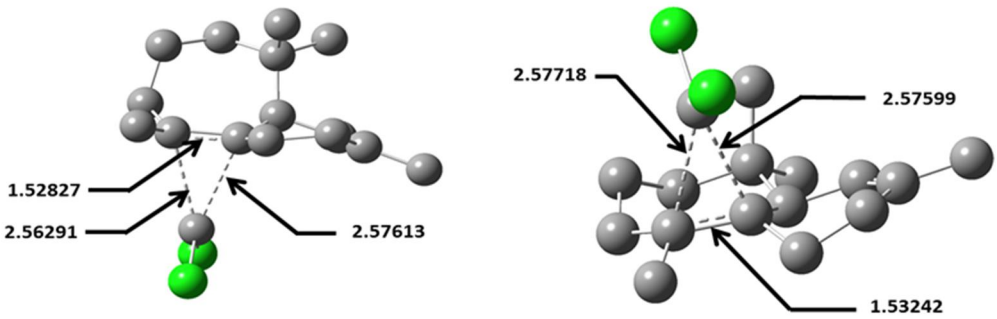

Fig. 6. Représentation des distances interatomiques (Å) des états de transition impliqués dans la réaction de cycloaddition entre le β-himachalène et le dichlorocarbène

Les géométries des états de transition sont représentées dans la Figure 6. Les longueurs des liaisons C_6-CCl_2, C_7-CCl_2 et C_7-C_6 aux TS_α et TS_β sont :

- En face α de la liaison C_6=C_7: d (C_6-CCl_2)= 2,57613 Å, d(C_7-CCl_2)= 2,56291 Å et d(C_7-C_6)=1,52827 Å
- En face β de la liaison C_6=C_7: d(C_6-CCl_2)=2,57599 Å, d(C_7-CCl_2)= 2,57718 Å et d(C_7-C_6)=1,53242 Å

Afin de montrer que les états de transition sont bien reliés aux minima (réactifs et produits), nous avons effectué le calcul IRC [29], [30], et nous représentons les courbes E=f(RC) dans la Figure 7.

L'optimisation de la dernière structure obtenue dans la direction des produits nous a donné des structures de même énergie que le produit final P_α.

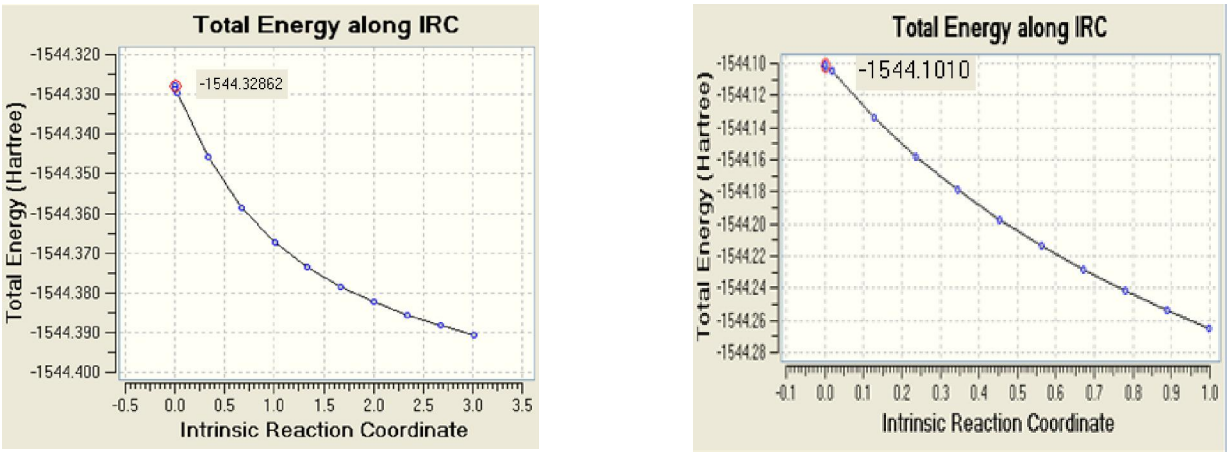

Fig. 7. IRC pour deux approches α et β

4.4 DEUXIÈME CONDENSATION

L'action de deux équivalents du dichlorocarbène sur le β-himachalène conduit à la formation de deux stéréo-isomères P_2 et P_3 selon la Figure 2. Afin de mettre en évidence l'existence de deux produits, et de montrer lequel est majoritaire, nous avons calculé les énergies totales, les énergies relatives et les énergies des états de transitions TS_α et TS_β (Tableau 3).

Tableau 3. Énergies totales (E) et énergies relatives ΔE* pour les points stationnaires de la deuxième réaction

	E (u.a.)	ΔE*(Kcal/mol)
β-himachalène + dichlorocarbène	-1544,5094	
Dichlorocarbène	-958,383	
TS_α	-2502,8391	33,445
TS_β	-2502,8398	33,006
Produit α	-2502,9477	-34,700
Produit β	-2502,9481	-49,252

La surface d'énergie potentielle correspond aux modes de cycloaddition en face α et en face β de la deuxième réaction.

La Figure 8 montre que:

- Le TS_β est situé à 0,007 u.a. au-dessous de TS_α. Les énergies d'activation correspondant aux faces d'attaques de la liaison C_2=C_3 du produit P_1 sont 33,006 pour l'attaque en face β et 33,445 (Kcal/mol) pour l'attaque en face α, par conséquent les deux régioisomères sont cinétiquement favorisés.
- La réaction de formation des produits P_2 et P_3 est exothermique par -34,700 et -49,252 Kcal/mol respectivement.
- La formation des produits P_2 et P_3 est thermodynamiquement favorisée.
- Le faible écart entre les réactions de cycloaddition des produits P_2 et P_3 montre que la formation des régioisomères est possible mais que le produit P_3 (en face α) est majoritaire. Ceci est en accord avec les constations expérimentales.

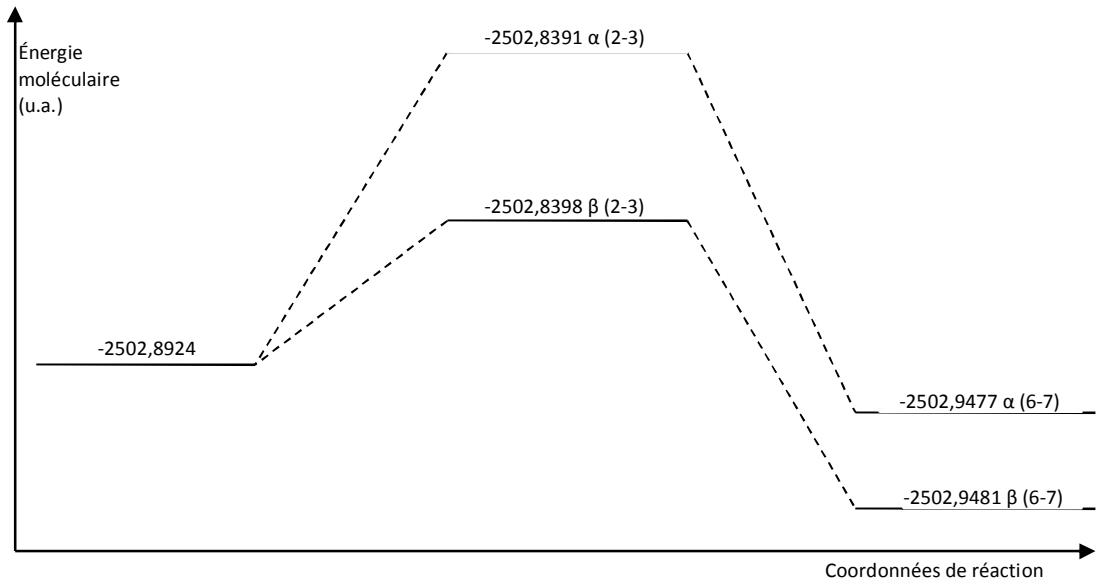

Fig. 8. Profil énergétique de la deuxième condensation entre un équivalent de β-himachalène et deux équivalents de dichlorocarbène

Afin de calculer les distances interatomiques impliquées dans la réaction de cycloaddition entre le produit P_1 et la dichlorocarbène nous avons représenté les structures des états de transition des deux modes de cycloaddition en face α et en face β (Figure 9).

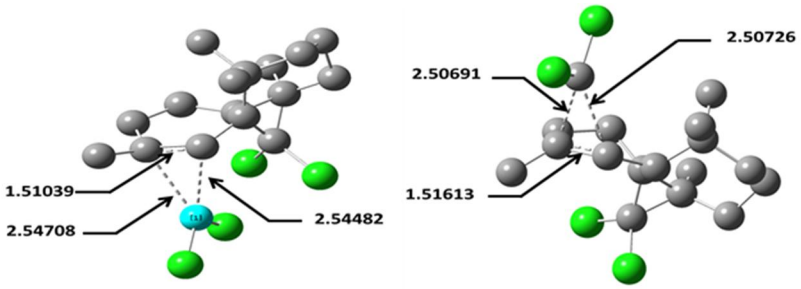

Fig. 9. Représentation des distances interatomiques (Å) des états de transition impliqués dans la réaction de cycloaddition entre P_1 et le dichlorocarbène

Les géométries des états de transition sont représentées dans la Figure 9. Les longueurs des liaisons C_3-CCl_2, C_3-CCl_2 et C_2-C_3 aux états de transition sont :

- La face α de la liaison C_2=C_3: d (C_2-CCl_2)= 2,54482 A, d(C_3-CCl_2)= 2,54708 A et d(C_2-C_3)=1,51039 A
- La face β de la liaison C_2=C_3: d (C_2-CCl_2)= 2,50726 A, d(C_3-CCl_2)= 2,50691 A et d(C_2-C_3)=1,51613 A

Par conséquent, ces états de transition correspondent à des réactions concertées.

5 CONCLUSION

Le calcul théorique par la méthode DFT au niveau B3LYP/6-31(d) de la carte d'isodensité de l'orbitale HOMO du β-himachalène, des énergies totales et relatives, des énergies des états de transition, et des distances interatomiques de la cycloaddition résultant de l'interaction entre le β-himachalène et le dichlorocarbène à température ambiante nous a permis de conclure que:

- Au cours de la première condensation l'attaque se fait uniquement en position α de la double liaison C_6=C_7. Cette réaction est chimiospécifique et stéréosélective.

- Au cours de la deuxième condensation du produit P_1 avec un équivalent de dichlorocarbène, l'attaque se fait au niveau de la double liaison C_2=C_3 en face α et en face β simultanément et donne naissance à deux produits notés P_2 ((1S,3R,8R,9S,11R)-2,2,10,10-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane) et P_3 ((1S,3R,8R,9R,11S)-3,7,7,11-tetrachloro-3,7,7,11-tetramethyltetracyclo[6,5,0,$0^{1.2}$,$0^{9.11}$]tridecane). Le produit P_3 (face β) est majoritaire. Ce résultat est en accord avec l'expérience.
- Les valeurs des énergies totales et relatives des deux réactions sont négatives, ce qui implique que les réactions sont exothermiques.

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Investigation of Six Sigma Practices and Process Innovation for Malaysian Healthcare Industry

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ABSTRACT: Healthcare industry has to face many significant challenges continuously in order to provide optimal performance. In order for Malaysia to achieve a developed nation status, improvements in term of healthcare services are required. Therefore, a quality management initiative is needed to achieve their goals. Six Sigma (SS) is clearly and proved as one of quality management initiatives for process changes. The abilities of organization to be innovative in industry give great impact to organization. In addition, process innovation can provide the additions of quality improvement toward product or service. Process innovation had been seen assist SS practices to achieve performance improvement. Thus, the purpose of this study is to review structural analysis between SS practices and process innovation. Examination of the research literature shows that there is a lack of empirical research that systematically examines the relationship between SS practices and process innovation. Therefore, this concept paper tries to examine how the SS can contribute on development of process innovation in healthcare industry. Next, the hypothesis has been developed based on the literature and the proposed research model for Malaysian healthcare industry also provided. For the future agenda, Structural Equation Modelling (SEM) techniques will used in order to get the empirical result.

KEYWORDS: Six sigma, process innovation, innovation, quality management initiatives, process improvement, healthcare.

1 INTRODUCTION

Healthcare industry is seen as an industry of great responsibility for the development of society and the nation. Coinciding with this, the healthcare industry should provide the great service to the community to incubate and form a healthy society which can contribute to the country. In order to look the welfare of citizen, the various programs and provision has been made by the Malaysian government. Through the presentation of the 2013 budget, a total of RM19.3 billion is allocated for operating and development expenditure in Malaysian healthcare industry [1]. Besides that, The Malaysian government establishing Malaysia clinic that aims to reduce the treatment costs to be paid by the people. This shows the healthcare industry to be one pillar in the development of the national economy.

In order for Malaysia to achieve a developed nation status, improvements in term of healthcare services are required. Reference [2] stipulate that Malaysia is in circumstance to provide the quality of healthcare in this country. Hence, one of the ways to achieve that goal is by implementing innovation in the healthcare industry that can assist to improve the quality in service. Nevertheless, [3] noted that there has been more challenging time for healthcare organizations to be innovative. This is because, healthcare industry face the challenges to be innovative in every process to be performed. Most of the department in the healthcare industry such as radiology, medication, surgery, pharmacy, and emergency involves human life.

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Hence, the improvement through innovation can assist to reduce medical errors and achieve their goals. On top of that, there are some of previous studies discuss the innovation effort in healthcare industry such as [4], [5] and [6]. The previous study highlight that process innovation gets the attention from the healthcare industry too.

In addition, process innovation should practices together through quality management initiatives. Various quality management initiatives that can be implemented in organizations such as Six Sigma (SS), Total Quality Management (TQM), Balance Scorecard (BSC), Lean Manufacturing and so on. Reference [7] found that TQM has a positive and direct effect on technological innovation in Spanish industrial firms. In addition, study by [8] found that the TQM (leadership and people management; process and strategic management; and open organization) has a positive impact with innovation product innovation; service innovation; and process innovation) in Vietnamese industry. Thus, the implementation quality management initiatives can be success with the help from employing innovation in organization. However, the previous studies concerns the relationship between quality management initiatives like TQM with innovation get the wide attention but unfortunately not for SS practices with process innovation. Hence forth, the purpose of this study is to review structural analysis the SS practices and process innovation for Malaysian healthcare industry.

Next, this paper is structured as follows: section 2 presents the literature review of SS practices, process innovation and development of the propose hypothesis; in section 3, the methodology is described; followed by section 4 presented the purposed research model; and finally in section 5, conclusion and future research are discussed.

2 LITERATURE REVIEW

2.1 SIX SIGMA PRACTICES

Six Sigma (SS) practices is one of the quality management initiatives that increasing organization to implement. SS practices has received substantial attention and being executed in businesses worldwide not only in manufacturing industry but service industry too for improve and reduce the level of defect in the customer's perspective. Reference [9] identified the main aims of SS efforts include improving customer satisfaction, reducing cycle time, and reducing defects. Meanwhile, referring to [10] describes that the important key in SS practices are determine the customer requirements and improvements which are made based on customer's definition of defects. Apart from the factor customer requirements, according to [9] stipulated that the important key of SS practices is to meet the needs of market and technologies. This factor gives beneficial not only to the organization but also to the customers, employees, and shareholders.

The Commonwealth Health Corporation (CHC) became the SS pioneer in healthcare industry whereby employed SS practices in March 1998 under General Electric [11]. After the success story of CHC who benefited from the implementation of the SS practices, many healthcare organizations followed it. Most of healthcare organization focused on direct care delivery, administrative support and financial administration when implement SS. Reference [12] investigated the Scottsdale Healthcare which executed SS practices at Emergency Department. The outcome of this study reported that time to transfer a patient from Emergency Department to an inpatient bed was reduced and gained profits at $600,000. In addition, researchers [13] explored the effect of employed the SS to implement the centers for disease control and prevention guideline for hand hygiene in four intensive care units in three hospitals and revealed that observed compliance increased from 47% to 80%, based on over 4,000 total observations. Hence the implementation of SS practices in healthcare industry had proved assist to achieve healthcare organization's goals.

Critical Success Factors (CSFs) in SS practices is important in order to gain the goals and great performance. Reference [14] stated the CSFs of SS consists management involvement and commitment; cultural change; communication; organizational infrastructure and culture; education and training; linking SS to business strategy; linking SS to customer; linking SS to human resources; linking SS to suppliers; understanding tools and techniques within SS; project management skills; project prioritisation and selection. Meanwhile, according to [15] identified the CSFs in service industry which are include the management commitment and involvement; company-wide commitment; cultural change; linking SS to business strategy; integrating SS with the financial infrastructure; organisational infrastructure; training and education; incentive program; customer focus; understanding the DMAIC methodology; project management skills; project prioritization and selection; and project tracking and reviews. However, in this study CSFs of SS practices for healthcare industry consist the four factors include leadership, customer focus, structured improvement procedure and focus in metric.

2.1.1 LEADERSHIP

To ensure business running smoothly, the organization should be led by an efficient leader. As a leader, they should master the leadership skills to manage their subordinates and process in organization. This is because, during the

implementation of SS, organization has to face many challenges that consist to gaining employee commitment and involvement [16]. Coinciding with this, leadership is needed to fill this gap by actively engage and socialize. Reference [17] also agreed leadership involvement is basis requirement to achieve the aims of SS practices. Besides that, referring to [18] noted that leader supports is needed in order to continuous improvement initiatives to be successful. By subordinate gain the support from leader continuously, they become more enthusiastic to do their work.

Reference [19] defines leadership as improvement specialist which is assigned with specific leadership roles and responsibilities in improvements teams. Hence, a leader takes the responsibility for determining the direction where his subordinate should be taken. On top of that, leaders also have to make decision and take the responsibilities to manage a work and prevent it from any damage and breach of duty that could affect the organizational performance and image. Thus, leadership is one of the CSFs that drive the implementation of SS practices in healthcare organization.

2.1.2 CUSTOMER FOCUS

Currently, customers more awareness towards the value of the product or service purchased. Comparison and evaluation is made before buying the products or services. Identify customers' requirements, expectations and needs become as the importance things to ensure the organizational performance can be achieved ([18],[20]). On top of that, every process of organization should meet the customer needs for increasing customer loyalty [21]. Customer loyalty plays an important role because it assists to enhance the organizational performance. In line with that, study by [18] said that the decision to determine customer's need can be critical to organization's long term survival. The stage of organization has a loyal customer, they continuously repurchase or reuse backs the products or services that provides by organizations. Furthermore, according to [22] stipulated the benefits to organization that get from loyal customer are the less cost to serve them; willing to pay more than other customer; and they act as word-of-mouth marketers for organization. At the end, the strength and durability of organization's brands will last longer in the market because of loyal customer.

Next, study by [17] stipulated that improvements efforts should focus on customers in order to achieve maximum effects when implementing SS practices. In addition, [23] found two key in customer focus which is the input process and the output procedure. In relation to that, input process require organizational to understand customer needs and integrate with organizational information while in output procedure, organization need to minimize variation of the process, reduce defects, and enhance process capability. Thus, by implementing SS practices in healthcare industry, organization should make a clear understanding the customer's expectation and requirements and finally give the great impact to healthcare organization.

2.1.3 STRUCTURED IMPROVEMENT PROCEDURE

To achieve the expected goals, improvement in operating structure is needed. Structured improvement procedure is one of the CSFs in SS practices to driven better performance in organization. For example, [17] defined the suitable key ingredients CSFs of SS practices and it adapted to vision, strategies, capability, and circumstance of a Korean company and found operating organization structured is one of them. Improvements in all operations should been executed in order to improve the quality of the product or service produced and to run the effective improvements in the organization, they must have effective planning and guidelines. Reference [24] noted that to increase the customer satisfaction, organization need to implement the effective improvement. Meanwhile, referring to [25] stipulated that improvement cannot be executed if don't have clear guidelines. Hence forth, the effective structured improvement procedure can be seen as one of the ways that can benefit not only to organization but also to its surrounding.

Reference [26] describe process improvement consist to remove the main problems that effect organizational performance and identify the solutions to it. Due to this, the structured improvement procedure assists to implement SS practices in organization. Therefore, in healthcare industry, the problem should be fixed immediately because it impacts on the customer (patients) that could harm them. Hence forth, structured improvement procedure is a step taken by healthcare organization to identify, analyse and make improvements on the organization's processes with a clear guideline in assist organization goal achievement.

2.1.4 FOCUS IN METRIC

Strategic performance measurement becomes one of the tools to see the overall organization performance. In line with the goals of the organization to improve performance in many aspects, the levels of performance for each unit in organization must be monitor and measure. The mechanism that often adopted today is the use of metrics whereby

associated with quality issues [27]. Focus in metric is one of the CSFs to assist process improvement in organization. Coinciding with this, study by [9] stipulated that SS provide a consistent way to measure the performance of a process or products. To keep the organization focused on the metric when implementing SS, employees play an important role to make it happen. This is because the best way to motivate the employees is introduce incentives or compensation a program in organization [17]. Thus, in order to implement SS practices in healthcare industry, organizations need to focus on the performance measures for assist organization to achieve their goal and continuously get customer loyalty.

2.2 PROCESS INNOVATION

At present, the challenges faced any organizations is the competition. In relation of this challenge, process innovation is needed to respond to these challenges [28]. Implementation of the process innovation can provide additions of quality to product or service. Reference [29] noted that innovation in process activities assist to increase the service quality. In healthcare industry, systematic and effective processes are emphasized. This is because healthcare organization aims to gain the higher quality of services to prevent the occurrence of negligence that might cause patient injury or death [30]. In order to avoid any carelessness that may pose a danger to patients, the process innovation is ideally suited to be adopted in healthcare organizations.

There are increasing numbers of empirical studies concern process innovations. For example, recently, [31] explored the relationship between the information technology adoptions with process innovation. From the research finding, they discovered that there is a significant relationship between information technology adoption and process innovation. Besides, study by [32] examined the effect of process innovations on firm total factor productivity growth in Spanish manufacturing firms. This study provided empirical evidence which that process innovations foster productivity growth in both for small and large firms.

In addition, according to [29] identified the three indicators of process innovation in Korean service industry which include operation innovation, customer relationship innovation, logistic innovation and organisation innovation. In relation all of previous study, this paper proposed process innovation in three indicators which are radical process innovation, incremental process innovation and service process innovation.

2.2.1 RADICAL PROCESS INNOVATION

To support the new improvement in business process organisation, need to implement radical process innovation as key to success. Radical innovation is defined as introduction of new product or process [33] and also major improvement or introducing the new process to organization and industry too ([34],[35]). Every organization has their own purpose and reason before implementing innovation. For example, [36] found that the reason for organization introducing radical process innovation is to increase their market share, to enter new market or foreign market, or to enlarge its product assortment. In healthcare industry, the radical innovation needs to be carefully managed because it assists to give a positive impact on customers and the industry itself if organization managed successfully and otherwise if failing. Thus, an effective radical process innovation should be adopted in order to attain the excellence performance in healthcare organization and industry.

2.2.2 INCREMENTAL PROCESS INNOVATION

Organizations that execute a process that has been successfully implemented by other organizations referred as adopted incremental process innovation. Incremental innovation defines as the continual process of improvement in organization ([35],[37]). Organizations in the healthcare industry can apply radical innovation on their existing processes because only dealing with low risk and onward assist to improve the performance. Based on [38] stipulated that to increase market life of their existing products or services in healthcare industry, organization have started exploring the incremental innovation because of the risk is more lower compared to radical innovation. On top of that, improvement in healthcare is urgent and important pursuit [39] because in healthcare industry, it is require zero tolerance for defects. By increasing the added value of existing processes, it assists for healthcare organization to achieve the goals.

2.2.3 SERVICE PROCESS INNOVATION

Services provided by the organization are evaluated by the customer. To ensure that the organization can keep a good image, organization need to improve the service by executed innovation in their service process. There a few researchers and authors defined the service process innovation. Reference [40] defined service process innovation as new development of service. Meanwhile, [41] refer service process innovation as redesign of service process delivery. Regardless of the definition

adopted, service process innovation is a new and improved ways in service delivery systems. Besides that, executed the service process innovation can assist organization to achieve the great performance in many perspective such as obtain better quality of service, able to getting efficient delivery system and improving the efficiency [42]. Implementing service innovation in healthcare organization is needed because nowadays, they are also support healthcare provision by offering health-check programs, prediagnosis testing, and follow up with the customers after treatment [6]. In line with this, healthcare organization must implement service process innovation for their growth and survival.

2.3 SIX SIGMA AND PROCESS INNOVATION

SS practices always defined as a process improvement by practitioners and researches [18],[30],[43],[44],[45] but the previous study concerning directly the relationship between SS practices and process innovation in healthcare industry still lacking. Reference [9] stated that to achieve the aims of SS, it requires breakthroughs in every area of operations. The absence of the innovation process, the difficulty of implementing SS can be seen. Reference [46] stated that SS projects deal with tasks, processes and operations. Improvements in the process will assist the implementation of SS. Hence forth, the process innovation is needed to assist when execute the SS practices accomplish organization goals.

Study by [47] examined the integration of SS practices and process improvement through Healthcare Quality Improvement Circle (HQIC) in dealing with troublesome needle-stick events that accoutred in a Taiwan hospital. The authors revealed that the accident rate decrease significantly when implement the SS and HQIC compared than before. In addition, [48] determined the overall sigma level performance of four processes of the Imaging Department (reception, X-ray, computed tomography, and radiologist diagnosis) considering process innovation through SS methodology. The finding showed that through implementation of SS on process innovation, the Imaging Department (ID) found to reduce defect after employed process innovation and obtained SS level (σ) which is higher than the initial sigma level of the ID before innovation employed in their process that was 36 patients per day with a process defect (σ = 2.0), following measurements in 15 days after process innovation was 28 patients per day with a process defect (σ = 2.2) and after 30 days of implementation was 24 patients per day with a process defect (σ = 2.3). Thus the SS practices have significant relationship to process innovation in healthcare industry.

To understand the relationship between SS practices and process innovation for Malaysian healthcare industry, the following propose hypothesis will be test.

H_1: *There is a positive and direct significant relationship between six sigma practices implementation and process innovation for Malaysian healthcare industry*

3 RESEARCH METHODOLOGY

The main aim of this study is to review structural analysis the SS practices and process innovation for Malaysian healthcare industry. Healthcare industries were chosen because the use of the requirement of quality management initiative and process improvement method in this sector is very important. Coinciding with that, the samples from healthcare industry were selected from the list of hospital in Malaysian healthcare industry. Next, for future, this study will use survey method to collect the data from sample. A set of survey questionnaire as a sampling method will carefully designed to ensure most of the issues concerning SS practices and process innovation were included.

Next, to find cause and effects between SS practices and process innovation, the Structural Equation Modelling (SEM) technique are employ to analyse the data gathered from the survey. Exploratory factor analysis, reliability analysis and confirmatory factor analysis to test the construct validity, reliability, and measurements loading were performed. Having analysed the measurement model, the structural model was then tested and confirmed. Besides that, to analyze the preliminary data and provide descriptive analyses such as means, standard deviations, and frequencies, the Statistical Package for the Social Sciences (SPSS) version 17 will use. On top of that, SEM using AMOS 6.0 will use to test the measurement model.

4 PROPOSED RESEARCH MODEL

Based on literature review, exploring process innovation get the wide attention from the practitioners and researchers but there are limited empirical studies that focus directly the relationship between six sigma practices and process innovation

in healthcare industry. In addressing the problems, authors propose to analyse the relationship between six sigma practices and process innovation for Malaysian healthcare industry. Figure 1 presented the proposed research model.

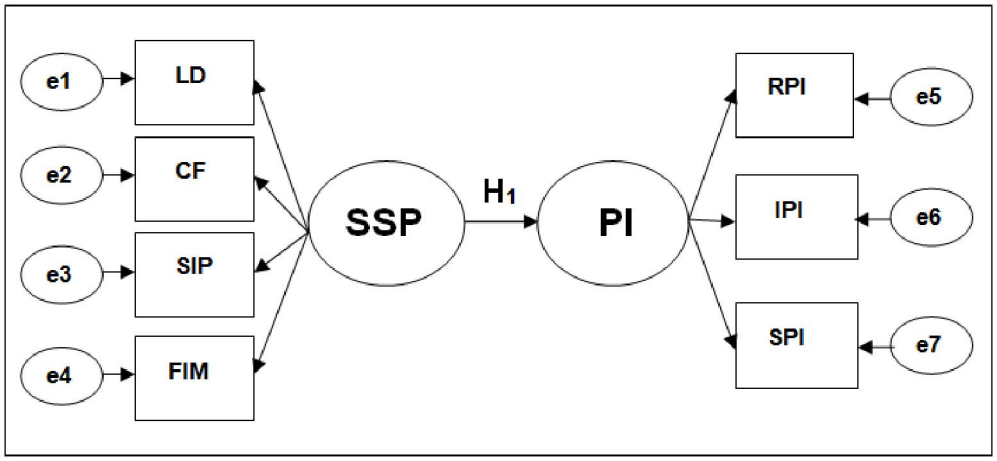

Fig. 1. Proposed Model of the Study

Note: SSP: Six Sigma practices; LD: Leadership; CF: Customer focus; SIP: Structured improvement procedure; FIM: Focus in metric; PI: Process Innovation; RPI: Radical process innovation; IPI: Incremental process innovation; SPI: Service Process Innovation

5 CONCLUSION

Recently, consideration has been made by customer before they buy or use the products or services. Coinciding with that, healthcare organization must improve their quality of product or services to meet customer requirement by improving the process. Process improvement supports the healthcare organizations to enhance healthcare outcomes. To implement SS practice, process improvement (through process innovation) assists the organization to achieve the targets that already set [48]. This paper provides the research review of SS practices and process innovation and attempts to make contribution in this area through a study based in Malaysian healthcare industry. Examination of the research literature shows that there is a lack of empirical research that systematically examines the relationship between SS practices and process innovation. In order to that, the purpose of this study is to carry out structural analysis the SS practices (leadership; costumer focus; structured improvement procedure; and focus in metric) and process innovation (radical process innovation; incremental process innovation; and service process innovation) for Malaysian healthcare industry. For the future agenda, a set of questionnaire are developed. Next, analyse according to SEM techniques will used in order to get the empirical result. Facts that have been highlighted in this study hopefully can contribute to the organization and researchers to investigate more deeply the relationship between SS practices and process innovation with better awareness.

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A Fast and Robust Traffic Sign Recognition

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ABSTRACT: Traffic Sign Recognition (TSR) system is an important component for the intelligent vehicles, it can assist and inform the driver about dangerous situations such as stop, icy roads, no entry or speed limits. In this paper we present a fast and robust traffic sign recognition system constituted of three modules which are: segmentation, detection and recognition of sign type. In the first module we start by applying a filter after normalization of the three RGB channels to extract red, green, blue and yellow maps. To detect the signs and identify their forms, in the second module we propose a new and fast approach for pattern recognition based on minimum bounding rectangle. For the third module, the recognition is made by using a matching directly between the SURF descriptors of the detected traffic sign and the traffic signs in the database, in this module we apply a filtering interest points detected and we keep only the points that are inside the pictogram's sign. The evaluation of the proposed approach gives good results compared to some powerful techniques. As a result, with the proposed system we have obtained a high performance with 95.65% sign detection, 97.72% traffic sign identification and 89.59% traffic sign recognition rate in an average time less than 80 ms/image.

KEYWORDS: Advanced driver-assistance systems, pattern recognition, image segmentation, road traffic, interest points, image color analysis.

1 INTRODUCTION

Automatic traffic sign detection and recognition, as an important task of Advanced Driver Assistance Systems (ADAS), has been of great interest in recent years. Traffic sign detection has a direct impact on the safety of driver, and damages can be easily produced due to their ignorance. Automatic systems developed to assist the driver [1], [2], [3], based on detection and recognition of signs can consequently correct the most unsafe driving behaviors.

To identify the signs, the most part of researchers divide the task in a three sequential stages: segmentation, detection and recognition. The role of the first stage is to determine the area of the signs in the road scene, whereas the detection selects areas that have an appropriate traffic sign shape. Next, recognition stage identifies the information of the extracted traffic signs. The approaches of identifying the signs can be classified into three main classes: geometrical methods which are based on the geometric shape to detect signs [4], [5], colorimetric methods which are based on the color in the detection phase [6], [7], [8], [9], and there are also methods that combine learning with the methods in the previous two classes [10], [11], [12].

In colorimetric methods the most popular color spaces used are RGB, HSV, HSI, YCbCr, and CIELab. In these approaches images are first converted to a designated color space and then a segmentation algorithm based on dominant color detects interest regions, these regions are then filtered by a recognition algorithm or model appearance. Escalera et al. [8], chose the HSI space to detect the signs, they considered only the H and S components to overcome the problem of brightness variations and use a thresholding to determine the dominant color to segment the image. RGB color space is used to threshold the image in [9]. Piccioli et al. [6], use color and a priori information to determine the interest regions and limit the possible locations of signs in the image. In another approach proposed by Chen et al. [13], based on SVF (Simple Vector Filter)

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which was proposed in [14], they found in their experiments that the approach gives good results in the separation of elements of red, blue and yellow.

In the case of geometrical methods, the detection of signs is made from image contours which are analyzed by a structural or global approach. These methods are generally more robust than colorimetric because they deal with the gradient of the image, and can process images in grayscale. A Hough transform was used by [5], to detect edges of the signs, after they select only the closed contours; recognition of candidates is done by a neural network. In [8], authors chose to use another technique called Radial Symmetry Transform (TSR) to detect speed limit signs, also it was used by [15]. Paulo et al [7], used a fast radial symmetry transform (FRST) detection method to identify circular shapes and Harris corner detection algorithm for triangular and square shapes. The authors in [16], detected circular and triangular signs using Color Distance Transform (CDT), the distance is computed for each color channel separately. To recognize the shape of the sign, the authors in [17], used the vector of Distance to Border (DTB), which is the distance between the outer contour and its bounding rectangle for each segmented blob there are four vectors DTB (left, right, top, bottom). In [4], authors developed a colored traffic sign recognition system based on Scale Invariant Feature Transform (SIFT).

In the approach [10], a cascade detectors increasing complexity is used, each detector is a set of classifiers based on Haar wavelet, these classifiers use a learning algorithm AdaBoost, a threshold in the HSI color space is used for segmenting a candidate blobs, the blobs are classified according to their shape by a linear support vector machine (SVM), and the classified blobs are recognized according to their patterns using non-linear SVM [18]. In [12], a threshold is applied over a HSV color space to segment the image, to classify the shape of an extracted candidate a method based on support vector machines (SVM) with a Gaussian kernel is used. To detect sign an evolutionary Adaboost and a classification through a Forest Error Correcting Output Codes (F-ECOC) framework are used in [11]. The authors in [19], proposed for recognition traffic sign to combine knowledge-based analysis and radial basis function neural classifier (RBFNN).

The rest of this paper is organized as follows: the next three sections present the proposed traffic sign detection and identification system. Section 2 presents the color segmentation of a traffic sign with a filtering method. In Section 3 we discuss the proposed approach to detect and identify signs in the segmented maps. The recognition approach of the sign type is described in Section 4. Section 5 illustrates the experimental results. Finally, the conclusions are given in Section 6.

2 TRAFFIC SIGN SEGMENTATION

The color information is a discriminative feature road signs, there are red, blue, and yellow signs, and to extract it a segmentation of image is required. Many authors use the RGB color space to avoid the time of conversion to another color space.

Chen et al [13], use the Simple Vector Filter (SVF) proposed by Asakura [14], they found in their experiments that this approach gives good results in the separation of elements in red, blue and yellow. For each pixel x = [XR, XG, XB] SVF is calculated using the following equation:

$$\begin{array}{ll} Red: & X_R - X_G > 40 \;\; and \;\; X_R - X_B > 40; else \; 0; \\ Blue: & X_B - X_R > 65 \;\; and \; X_B > 45; else \; 0; \\ yellow: & X_R - X_B > 50 \;\; and \; X_G > 50; esle \; 0; \end{array} \quad (1)$$

In this approach the rate of unwanted pixels is very small compared to previous approaches, but this approach is closely linked to thresholds, in some pictures where there is a great change in lighting, signs are not detected.

In another approach [16], a filter is applied for each pixel of the RGB image by a set of transformations:

$$\begin{array}{l} f_R(X) = max(0, \min(x_R - x_G \, , x_R - x_B)/S) \\ f_B(X) = max(0, min(x_B - x_R \, , x_B - x_G)/S) \\ f_Y(X) = max(0, min(x_R - x_B \, , x_G - x_B)/S) \end{array} \quad (2)$$

With $S = x_R + x_G + x_B$

In this approach signs have a high intensity, which facilitates their detection after thresholding of the image, but it also generates unwanted noise pixels in the yellow map such the green color is seen as yellow.

King et al. [19], normalize the three RGB channels by the intensity I to avoid the problem of lighting, where:

$$I = \frac{R + G + B}{3} \quad (3)$$

and r, g, b are the normalized red, green and blue channels of the input image.

$$r = \frac{R}{I}, g = \frac{G}{I}, b = \frac{B}{I} \tag{4}$$

The maps red, green, blue and yellow are constructed by the following equations:

$$\begin{aligned} R' &= r - \frac{g+b}{2} \\ G' &= g - \frac{r+b}{2} \\ B' &= b - \frac{r+g}{2} \\ Y' &= \frac{r+g}{2} - \frac{|r-g|}{2} - b \end{aligned} \tag{5}$$

Signs with this approach are distinguished, but in the results of our experiments when comparing the red map with the same map of the previous method [13], we found in this approach that the rate of unwanted pixels are high, and unwanted pixels present in the red map are also present in the green or yellow maps.

In our approach we have improved the approach proposed in [19], the idea of our filter is to remove unwanted pixels in the red and yellow maps.

The filtering procedure is described as follows:

1. A pixel p(x, y) which has a high intensity in the red map and green or yellow maps, this is an undesirable pixel in the red map, but not necessarily in the yellow map.
2. To be undesirable in the yellow map we use a threshold, the pixel is considered undesirable if its blue or green value is below the threshold α, the value obtained after experiments is: α = 180.

Fig.1 present the results of the proposed filter, it shows a comparison between the images before and after filtering. If we see the results in Fig.1 (e, f, g) of our filtering we found that we have eliminated almost unwanted pixels and we obtained the best results in the yellow map.

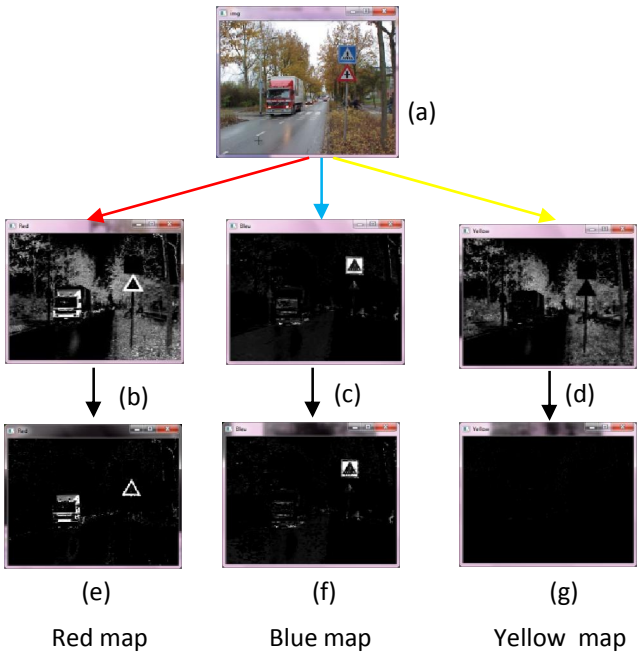

Fig. 1. Effect of the proposed filtering, (a) original image RGB, (b) (c) (d) segmented images before filtering; (e) (f) (g) after filtering segmented images

3 TRAFFIC SIGN DETECTION

After the extraction of pattern maps with the proposed filtering method, the signs are located and at this stage it is necessary to distinguish them from their backgrounds to recognize their forms. This distinction is made by detecting limits of the sign based on its contour. We have proposed a new fast approach to pattern recognition, in this approach we used a rectangle that encompasses the detected contour to characterize its shape. To detect the shape of a sign we used a score of intersection between the detected pattern and the four lines of the rectangle.

3.1 CALCULATION OF THE MINIMUM BOUNDING RECTANGLE

To recognize the shape of the sign candidate, the idea of our approach is to compare the detected pattern with the rectangle that encompasses it named "BoxOut", we calculate a score of intersections between the contour of the pattern and the four lines of the BoxOut as follows:

- Score0: If there is no intersection between the contour and the line of the BoxOut;
- Score1: If there is a small intersection in few points between the contour and the line of the BoxOut;
- Score2: If the intersection occupies nearly a quarter of the line of the BoxOut;
- Score3: If the intersection occupies almost all the line of the BoxOut.

In TSR we have the advantage that there are four forms: rectangle, triangle, circle and octagon, which facilitates work and helps us to deduce the type of any sign based on the score of intersection calculated. Fig.2 shows the proposed approach.

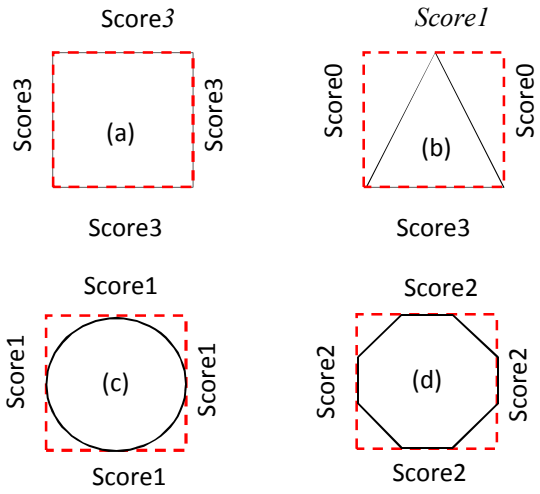

Fig. 2. The proposed detection approach (a) rectangle, (b) triangle, (c) circle, (d) octagon

By observing Fig.2 we find that each form has a different distribution of scores, which allows us to consider as a discriminant characteristic:

- Rectangle is composed of (score3, score3, score3, score3);
- Triangle is composed of (score3, score0, score1, score0);
- Circle is composed of (score1, score1, score1, score1);
- Octagon is composed of (score2, score2, score2, score2).

To ensure that the proposed approach is robust to rotation, we seek the minimum rectangle that can encompass the contour, as shown in Fig.3.

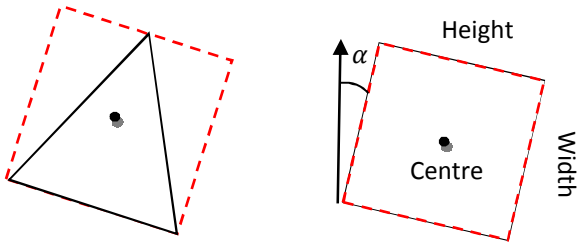

Fig. 3. Illustration of using the minimum rectangle that encompasses the form

For finding the minimum rectangle that encompasses the contour we use a specific structure to represent the rectangle, as shown in Fig.3 the information required for the representation are: the gravity center of the rectangle, the height, the width and the angle of rotation, which are obtained by using the cvMinAreaRect2 function of the OpenCV[1] library, once we have the height, the width and the center of gravity it's easy to calculate the coordinates of the rectangle.

As we explained above, to recognize the form we must calculate an intersection between the contour of this form and the BoxOut that encompasses it. Made that the four points of the BoxOut are obtained, they will be used to calculate the functions of each line, and the calculation is provided by a:

$$\begin{aligned} &\Delta_1 = a1x + b1 \\ &a1 = (P2.y - P1.y)/(P2.x - P1.x) \\ &b1 = P1.y - a1 * P1.x \end{aligned} \tag{6}$$

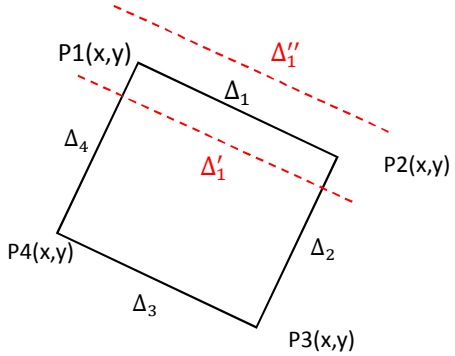

Fig. 4. Illustration of the four lines of the BoxOut

The same for all other lines (Δ2, Δ3, Δ4) of the BoxOut. And to reduce the noise problem we proposed to calculate for each line Δ two parallel lines Δ' Δ'', the whole forming a band instead of a straight line such that:

$$\begin{aligned} &\Delta' : y = ax + (b - \varepsilon) \\ &\Delta'' : y = ax + (b + \varepsilon) \end{aligned} \tag{7}$$

[1] *http://opencv.org/*

Now the score of intersection is calculated between the outline of the shape and the four bands of the BoxOut.

The Bilateral Chinese Transform (BCT) proposed by Belaroussi et al. [20], detects the circular and polygonal signs, but to detect the triangular signs they combine between the detection of the peaks and the center of the triangle, and for the rectangular signs they did not specify what type of transformation used. The major disadvantage of this approach is that for each type of sign they use a different transformation, they use three detection algorithms ellipse, triangle and quadrilateral, the final form will be chosen depending on the degree of compatibility provided by each of the algorithms. Against in our approach we use a single method to recognize the form of the candidate, so one treatment is performed instead of three treatments.

The Radial Symmetry Transformation in (TSR) is used in [8], to detect speed limit signs, but the disadvantage of this approach for triangles signs is that it can only find the size and position of the forms: it cannot distinguish a give way sign and intersection sign. Whereas our approach can distinguish between them because we know on which line of the BoxOut there is an intersection with the contour.

The approach proposed by Reina et al. [21], applies a reorientation on the detected signs to make it robust to rotations, but our approach is robust to rotation with no need to reorient the form. The transformation distance used by Ruta et al. [16], to solve the problem of scaling requires several models, one model for each shape on different scales, even with the use of a hierarchy of models their approach is very time consuming process. While our approach is fast and robust to changes in scale as it calculates a score of intersection just compared to the width or height of the BoxOut.

The vector of the DTB (Distance to Borders) proposed in [17], their approach is robust to the rotations and translations but not really to changes in scale because they zoom all candidates signs to 36×36. Thus the major drawback is the size of DTB vector, for each candidate there is four vectors DTB of size 1×36, but in our approach we use four scores of intersection, the global vector will be of size 1×4, which proves its robustness to scale changes.

4 TRAFFIC SIGN RECOGNITION

The color and shape of the sign are identified at this stage, to recognize the sign type of a query image we compare it with a database of signs, which are classified according to their color and shape in order to accelerate research. The comparison is based on the calculation of a matching measure to determine the nearest sign.

To use a matching directly by calculating the correlation of descriptor between the query image and the images in the database is highly sensitive to the background noise present in the query image, that is why we chose to use a matching based on interest points for their robustness to noise, rotation and illumination changes. In our work we have chosen to use the SURF descriptor because the comparative study of Juan et al. [22], demonstrates the superiority of SURF descriptor against SIFT and PCA-SIFT in terms of the runtime performance and robustness to illumination changes.

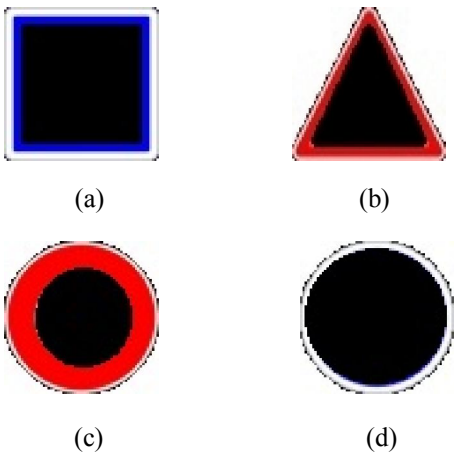

Fig. 5. The signs models, (a) indication, (b) warning (c) Prohibition (d) obligation

In this phase we try to match pictograms signs, we apply filtering to the interest points detected in the query images to delete points on the background and keep only the points that are inside the pictogram, we have created for each class of signs a sign model to filter the interest points detected as shown in Fig.5. The interest points detected outside the black sign model are rejected, in order to leave the interest points that represent the pictogram.

5 THE MATCHING

The matching is used to reduce the semantic gap between low-level (extraction and description) and high-level (recognition) while seeking the pair of points with a high similarity, each point of the query image is associated to the nearest interest point in image of the database.

Marius in [23], uses the principle of random KD trees proposed in [24]. KD trees are used to structure the search space to accelerate the comparison of an element with the others, but the search performance of a KD trees are close to those of a linear search when the size of the data space is large. KD trees would not be as effective for SURF with 64 dimensions. As the number of interest points does not exceed twenty points and SURF descriptor size is 64, the Brute Force algorithm matcher appears efficient.

Once we found the right match between the interest points of the pictogram and those of the image of the database, it remains to measure this matching to select the closest image. Computing a measure of correlation between the descriptors of matched points of the two images, then to choose the pair having a maximum correlation does not give good results, for this we chose to combine a coefficient σ_{pq} with the sum of distances as follows:

$$Dist(p,q) = \frac{\sum_{i,j=1}^{N} \mathrm{dist}(p_i,q_j)}{\sigma_{pq}} \quad (8)$$

With $\sigma_{pq} = \text{number of good matches}$

The number of good matching between the descriptors of two images is calculated by setting a maximum distance between the descriptors, that we keep the pairs of descriptors that have a distance below the threshold. The closest image is the one that has a minimum distance Dist, an example of matching results is shown in Fig.6.

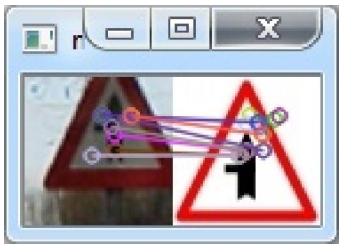

Fig. 6. Matching query image with the closest image

6 EXPERIMENTAL RESULTS

Our system is divided in to three modules: the segmentation module, the signs detection module and the signs identification module. The segmentation module is used for locating the sign it generates four maps after segmentation, the detection module uses maps to detect the sign and recognize its geometric form, in the identification module we detect interest points in pictogram sign to identify it.

Our traffic sign recognition system has been developed based on visual C++ using the Intel® Open Source Computer Vision Library (OpenCV). To evaluate our system, experiments were performed on the real data. The database traffic sign image consists of 48 images with 360×270 pixels containing three different traffic signs[2].

To evaluate the performance of our system we evaluated each module separately, we use a series of measures, we divide all the tests into two groups positive examples and negative examples, and we define:

- **TP**: the number of true positives, the number of true signs detected or identified;
- **FP**: the number of false positives, the number of non-detected or identified signs;
- **TN**: the number of true negatives is the number of non- signs undetected;
- **FN:** the number of false negatives is the number of true signs undetected.

6.1 EVALUATION OF SEGMENTATION MODULE

The segmentation module is very important because it consists of locating and detecting the maximum road signs and rejecting most of the other objects. The evaluation of the segmentation module consists in measuring the capacity of the module to locate the signs and ignore the background of the scene, which facilitates the detection of signs.

Our segmentation module is able to segment correctly 46 of 48 road scene images with only 1 false positive in an average time with filtering less than 7 ms/image. We note that the proposed filter gives good results, where the rate of FP eliminating in the maps generated with the approach [19], achieved 85.71% and 90% with maps generated with the approach [16]. Table 1 summarizes a comparison of results.

Table 1. Performances of the segmentation module.

Category / *methods*	*Number of images*	*TP (signs)*	*FP (signs)*	*FN (signs)*
Our method	*48*	***46***	***1***	***2***
Method [19],		*46*	*7*	*2*
Method [16],		*44*	*10*	*4*

We got very good results of segmentation; we can well segment 46 of 48 road scene images with 1 false positive and 2 false negative.

6.2 EVALUATION OF THE DETECTION MODULE

This module consists of detecting road signs and estimates their geometry to properly identify the class of candidate sign, in this module we try to detect the shape of signs in the maps generated by the segmentation module. Of 46 images provided by the segmentation module, the traffic signs were extracted correctly 44 images. In table 2, the sign detection module achieved 95.65% of correct detection rate. In addition to the high detection rate, the detection time does not exceed 1 ms/image. The number of FP in this phase is the FP results generated by the segmentation phase.

The high rate of detection demonstrates the ability of the proposed approach to detect signs, our approach arrive to detect signs in images even in different condition (lighting, rotation and zoom).

[2] *The image database of traffic signs is available at: http://www.cs.rug.nl/~imaging*

Table 2. Performance of the detection method of geometric signs shape.

Category	*TP*	*FP*	*FN*
46	44	1	2

The final evaluation part is dedicated to evaluating the recognition module of signs.

6.3 EVALUATION OF THE RECOGNITION MODULE

This module is to recognize the sign detected by matching it with the signs of the corresponding class. The matching is applied on the SURF descriptors computed around interest points detected on the candidate image and the images of the database.

Before filtering interest points we identify from 44 signs detected in the detection phase 31 with 2 false positives, but after filtering, where we keep only the interest points representing the pictogram, we correctly identify 43 from 44 signs with only 1 false positive because we set a threshold on the measure shown in Equation (8) and we accept only the signs with a distance less than 0.70; from 44 images candidates the recognition module achieved 97.72% of correct recognition rate. Table 3 shows the performances of the recognition module. With filtering interest points we can identify 43 candidate images of 44 images with only 1 false positive.

Table 3. Performances of the recognition module.

measures / *Filter*	*Number of targets*	*TP*	*FP*	*FN*
Before filtering	44	31	2	13
After filtering	44	43	1	1

Table 4 summarizes the evaluation of our system, we present the rate of TP, FP and FN for the different modules and the entire system. In the segmentation phase we detect signs with 95.83% and 2.08% of FP, and in detection phase 95.65% of the segmentation results are correctly detected with 2.17% of FP, in the recognition phase 97.72% of the signs detected are correctly identified with 2.27% of FP.

Table 4. Performances of our traffic signs recognition system

Module	*TP*	*FP*	*FN*
Segmentation	95.83%	2.08%	4.16%
Detection	95.65%	2.17%	4.34%
Recognition	97.72%	2.27%	2.27%
System	89.59%	6.25%	10.41%

The results obtained by our system are very encouraging, we are able to correctly identify 89.59% of the images processed by our system in an average time less than 80 ms/image. The proposed approach not only provides accurate identification signs, but it is insensitive to the differences appearance of the signs (lighting, rotation and zoom) in the real world.

Some detection simulation results are shown in Fig.7. Traffic signs can be detected and identified correctly in various color and shape.

Fig. 7. Examples of query images in the database

7 CONCLUSION

In this paper we have presented a system for detection and identification of traffic signs in a color image. Our system is divided into three phases: The first one concerns the segmentation and location of signs in images, the second is for the detection of the geometric shape of signs already located and the third is to identify the type of signs. In the first phase the filtering applied on the generated maps eliminates almost all unwanted pixels. In the phase of detection form we have proposed a method for pattern recognition by using a minimum bounding rectangle that encompasses the contour, this method detects the shape of the sign with a high detection rate of 95.65%. The detected signs are extracted and passed to the recognition phase. To identify the type of sign we applied a matching between descriptors SURF of sign detected and those of images in the database signs. In this phase we obtained a high identification rate of 97.72%. As a result, the proposed solutions have allowed developing a system with high performance with 89.59% identification and recognition rate. In this paper only single images are considered. In future works, we will focus on the implementation of robust traffic sign in video traffic sequences.

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Climate Change, Natural Disaster and Vulnerability to Land Displacement in Coastal Region of Bangladesh

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ABSTRACT: The climate change is a frequent feature accompanied by chronology of major disaster in the coastal areas of Bangladesh. Particularly coastal and offshore areas of Bangladesh are widely vulnerable to natural disasters due to its geographical location and very high population density. This paper attempted to study the land displacement pattern and possible vulnerability faced by internally displaced persons in the pace of natural disasters, and to identify the interrelated aspects of possible socioeconomic impacts of tropical cyclone, storm surge, river erosion, flood and drought on the coastal inhabitants. The study concentrated on the recent five environmental disasters. Sample survey into the selected costal region was undertaken to obtain data on land use, settlement and displacement pattern. Focus group discussion (FGD) was also undertaken to understand the vulnerability to short-term hazards, in particular, tropical SIDR and AILA impacts. SPSS 16 and ATLAS.ti were used to analyze data. The study found that the rate of landless households increased alarmingly due to frequent disasters which significantly caused the declining availability of land. Similarly the number of petty land owners increased significantly, while the hand medium and high land owners decreased over the years. It also found that frequent disasters in every year compelled the farmers to sell their land consistently because these displaced lands became unusable due to its excessive salinity and long time water logging. Consequently life, livelihood and occupation of these vulnerable people were widely affected and force them to outward migration especially towards urban areas.

KEYWORDS: Vulnerability, Coastal inhabitants, Land displacement, Short-term hazards, Environmental migration.

1 INTRODUCTION

Climate change and disaster induced land displacement emerged in the research agenda on global environmental change in the recent decades with the realization that land displacement occurred due to environmental disruption, either be manmade, natural or both. This study investigates into the pattern of climate change and disaster induced land displacement during last 5 years along with the possible socioeconomic impacts of climate induced natural disasters such as cyclone, storm surge, river erosion, flood and drought.

Current evidence strongly suggests that the concentration of climate change causes an increase in the frequency and the severity of sudden onset of natural disasters like flood, cyclone drought, riverbank erosion and salinity intrusion. Bangladesh seems to be one of the worst victims of climate change ravaged by major disaster events like 1998 flood, 2000 flood, 2007 cyclone SIDR and 2009 cyclone AILA. The cyclone SIDR and cyclone AILA displaced over 33 thousands people from their land and damaged crops of 112,879 hectares [1]. Even after a long time of occurrence of SIDR and AILA, most of the lowlands still remain waterlogged or under submergence, and farmers cannot use their submerged lands due to soil salinity. Alternatively in view of the high probability of climate change, the impacts of climate change on coastal areas a one-meter rise in sea level could displace nearly at least 2 million people from their homes in Bangladesh [2].

Reference [3] shows on climate change impacts in Bangladesh, 45-50 cm rise in the sea level along the Bay of Bengal coast will submerge about 11 percent of the country's land area (1600 sq km) by 2070 and this submergence will cover nearly 75 percent of the Sundarbans forest [4]. Recent studies shows that thirty eight coastal vulnerable upazilas of the districts of

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Shatkhira, Khulna, Bagherhat, Jhalakathi, Barguna Ptuakhali, Barishal, Bhola, Lakkhipur, Noakhali, Chittagong and Cox's Bazar experiencing permanent loss of large areas of coastal land affecting 35 million people- about one-quarter of the country's population [5].

Past study predicted that Bangladesh would have 15 percent of land inundated with a 1.5 m rise altogether and 21.3 percent of agricultural production could be lost, mainly rice, sugarcane and jute [6]. Past flood studies suggest that about 60 percent land area of Bangladesh is flood prone while 25 percent of land is inundated during the monsoon [7]. These flooded arable land, damaged food crops and reduced agricultural production, permanently. Farmers could neither cultivate water-logged fields nor can yield their expected produce later decrease in exports due to disruption of production process including transportation infrastructure. Flash floods and storm surges lead to increased salinity and decreased output of farmland. It is found that after cyclone SIDR and cyclone AILA the seasonal migrants who migrated toward urban area, all of them were displaced farmer, seeking different opportunities for survival even driving an auto rickshaw, and pulling a rickshaw or rickshaw van. Hence the impacts are definitely evident which are taking place not only the population alone, but also on the large amount of high- valued land property for residential as well as agricultural purpose.

Thus changes in the climate is likely to take place more rapidly over the next few decades and obviously, flood, storms, cyclones will occur more frequently in great intensities. Therefore study of land displacement seems to be an interesting issue which needs to be brought into discussion.

2 OBJECTIVE OF THE STUDY

The overall objective of the study is to prepare a synthesis for the general relationship between climate change induced natural disasters with land displacement for Bangladesh. In particular this study examines following specific objectives:

1. To study the existing land use pattern of land displacement during last 5 years in the study area,
2. To determine the extent of land displacement due to climate change in the selected area,
3. To find out the possible socioeconomic impact of cyclone, storm surge, river erosion, flood and drought on the coastal inhabitants,
4. To suggest appropriate policy options addressing climate change and mitigation measures.

3 METHODOLOGY AND SOURCES OF DATA

The study is based on primary data and a multistage sampling technique was adopted. To collect data Bagherhat district of southwest coastal region of Bangladesh was purposively selected, where severity of climate change impact is more visible. Then Sarankhola upazila of Bagherhat district was again selected purposively. Then at the third stage three villages namely Rainda, Khontakhata and Southkhali were purposively selected to collect data from the target respondents. Thus the people of these three selected villages formed the active population for this study. To determine an appropriate sample size 10 percent of the households of the selected villages were drawn as the target respondents who were the victims of climate change.

Thus a total of 100 respondents were drawn as the sample size in the process of survey. A questionnaire containing both close-ended and open-ended was prepared to collect data. The questionnaire was pre-tested before final data collection. Data were obtained from general households, who were selected from each village following a systematic random sampling technique: 1 household was chocked after 4 houses. The survey formats were designed to understand the condition of existing land use pattern, settlement and displacement pattern although land displacement status was ascertained for the last five natural disasters. The survey was conducted during June, 2011. Besides a Focus Group Discussion (FGD) was also conducted with 12 respondents (6 male and 6 female of different age group) which usually started with formal and open strategy. FGD lasted two hours and every participant completed written informed consent prior to the start of the focus group. In the FGD study, the primary concern was with vulnerability to *short-term* hazards, in particular, tropical SIDR and AILA impacts. Collected data were processed for subsequent analysis using software such as SPSS and ATLAS.ti[1].

[1] **ATLAS.ti** *is a powerful workbench for the qualitative analysis of large bodies of textual, graphical data.*

4 RESULTS AND DISCUSSION

4.1 EXISTING LAND USE

Although diversified uses of land were found in the study area, agriculture and water body occupied the dominating feature. A huge area of land were predominantly used for agricultural purpose over the years although, some area were used seasonally for shrimp cultivation and crab fattening. A considerable area under arable land totally free from shrimp cultivation was used only for agricultural purpose. The cultivated area dominates land use, covering nearly two-fifth of the total land. Household settlement was another significant feature of land use, which covered most of the highlands of the study area. Land use pattern of the study area was mainly dominated by low and low-middle income farmers, crab fattener and shrimp fry collectors and *gher* owner's settlement. Land use in view of social institutions is mostly *Hat*/*Bazzar*, Schools, Post office, Mosques, Church, Temple, Community Clinic, and Settlement Office.

Table 1. Existing Land Use Pattern of the Study Area

Land use		Total area (acre)	Percent	
Household Settlement		924	26	
Commercial		143	4	
Water body	Pond, Ditches, River	285	8	18
	Permanent *Gher*	355	10	
Gher & Agriculture		1387	39	
Institution		249	7	
Road		107	3	
Others		106	3	
Total		3556	100	
Source: Field Survey, June, 2011				

Table 1 summarizes existing land use pattern of the study area. Major lands of the study area were used for gher and agriculture (39 percent) followed by household settlement 26 percent, water bodies i.e., pond, ditches, river and permanent *gher* 18 percent and so on. Although a negligible amount (3 percent) of land was used for road networks, the physical condition of roads was poor that is partly semi-pukka[2] and mostly kacha- made of mud.

Table 2. Distribution of Current Land Ownership

Unit	Percent	
Landless	26.7	
1-10 katha	25.1	73.3
10-19 katha	24.2	
1-10 bigha	11.2	
20-30 bigha	8.1	
Over 30 bigha	4.7	

Source: Field Survey, June, 2011 Note: 1 Acre = 60.61 Katha, 20 Katha = 1 bigha

Table 2 shows the distribution of current land ownership pattern. The study found that almost 73.3 percent people have their own homesteads in their villages. This ownership of land mostly achieved through their descendents. Even though the

[2] Permanent structure built with concrete

land has lost its conventional value, people still remember quite well the amount of land they owned. In this area about 26.7 percent don't have land, while only 25.1 percent population owned 1 to 10 *katha* land, whereas about 4.7 percent people owned over 30 *bigha* land. These lands were used for fishing, crop, and livestock and not for gardening, as people have general lack of knowledge regarding gardening.

Table 3. Comparative Land Ownership Pattern According to Years

Unit of Land	Amount of Land				
	Current	2 years ago	5 years ago	10 years ago	15 years ago
Landless	26.7	23.4	9.8	3.2	1.5
1-10 katha	25.1	11.2	14.2	11.5	10.3
11-19 katha	24.2	24.6	27.0	27.0	28.1
1-10 bigha	11.2	20.0	23.9	32.7	30.3
20-30 bigha	8.1	11.0	17.3	18.9	20.9
Over 30 bigha	4.7	9.8	7.8	7.3	8.9

Source: Field Survey, June, 2011

Table 3 shows that currently 26.7 percent of households are landless, the figure was 23.4 percent, 9.8 percent, 3.2 percent and 1.5 percent land only before 2 years 5 years, 10 years and 15 years respectively. Thus over the years the rate of landless households increased alarmingly. Similarly the number of petty land owners having 1 to 10 katha land increased significantly over the years. For example currently 25.1 percent of the land owners became petty land owners; the figure was 11.2 percent 14.2 percent 11.5 percent and then 10.3 percent before 2 years 5 years, 10 years and 15 years respectively. By contrast medium and high land owners ranging from 11 to 19 katha, 1 to 10 bigha, 20 to 30 bigha decreased over the years. The surveyed data demonstrate that frequent disaster in every year compelled the farmers to sell their land consistently.

Table 4. Yearly Land Loss in Terms of Taka (Thousand)

		< 10	10-30	31-50	51-70	71-90	91-110	111-130	131-150	>150
Landless	Current Land	*	*	*	*	*	*	*	*	*
	2 Years Ago	13%	19%	6%	5%	2%	*	*	*	*
	5 Years ago	*	*	11%	15%	3%	11%	2%	13%	*
1-10 katha	Current Land	6%	3%	2%	1%	*	*	*	*	*
	2 Years Ago	7%	12%	11%	9%	*	*	*	*	*
	5 Years ago	*	*	*	7%	11%	3%	13%	15%	*
11-19 katha	Current Land	2%	2%	1%	4%	*	*	*	*	*
	2 Years Ago	*	*	17%	19%	11%	*	*	*	*
	5 Years ago	*	*	10%	13%	21%	*	*	*	*
1-10 bigha	Current Land	*	5%	9%	11%	9%	4%	*	*	*
	2 Years Ago	*	*	2%	*	*	1%	6%	1%	*
	5 Years ago	*	*	*	*	12%	12%	14%	9%	5%

Source: Field Survey, June, 2011

Intergovernmental Panel on Climate Change (IPCC) predicted that the future disasters under climate change could be both more frequent and severe than in previous years, hence vulnerability of land displacement and its capacity to adapt demands closer examination. Table 4 shows how people of the study area became landless due to the adverse affects inflicted by natural disaster, and clearly illustrates the vulnerability of agriculture to severe climate conditions. People currently having 1 to 10 *katha* land 5 years ago approximately 7 percent had land property of Tk between 51000 to 70000

although in the same year 11 percent, 3 percent, 13 percent and 15 percent had land property fairly (between 71000 to 90000), (between 91000 to 110000), (between 110001-130000) and (between 130011-150000) taka respectively. Similarly, the landowners currently having 11-19 *katha* land owning 2 percent value less than 10000 Tk whereas 12 percent household have land value ranged (between 10000-300000) Tk. Five years before approximately 10 percent, 13 percent, and 21 percent had landed property fairly (between 31000-50000), (between 51000-70000), and (between 71000-90000). Hence from the information in the table 4 we can see that there seems to be a relationship between land displacement and continuous disaster.

4.2 SETTLEMENT AND LAND DISPLACEMENT PATTERN

This estimate is based on periodical agricultural census 1996 and shows that per capita net cultivable land has declined from 0.6 to 0.13 hectare after SIDR (MofDM, 2007). Frequent disasters such as floods, cyclone, and land erosion significantly caused this declining availability of land. Moreover these displaced lands are still unusable due to its excessive salinity. People could never cultivate these lands only because of its infertility owing to salinity after cyclone SIDR and AILA. The impact of sea level rise will further intrude the saline water to landward. The rate of saline water intrusion will also affect the ability of the ecosystem to adapt.

4.3 LAND DISTRIBUTION PATTERN BEFORE AND AFTER SIDR

Fig. 1. Land Distribution Pattern before and after SIDR

From the above figure it has been clarified that the total displaced land whereas the left sided map represents the land distribution pattern before cyclone SIDR and the right sided map represents the land distribution pattern after cyclone SIDR.

Table 5. Area of Flooded Agricultural Land According to Flood Depth (SIDR)

Class	Flood Phase	Area (Sq. Km.)		Percent	
F0	Non-Flooded	38.67		13.3	
F1	Shallow Flood	63.98	252.04	22.02	86.70
F2	Medium Flood	121.58		41.82	
F3	Deep Flood	66.48		22.86	
F4	Very Deep Flood	0.00		0.00	
Total		290.71		100.00	

Source: Field Survey, June, 2011

The data in Table 5 depicts that total agricultural land in the study area was 290.71 sq. km, out of which a total of 252.04 sq. k.m agricultural land became inundated by determined gauge level. This inundated area is 86.70 percent of the total agricultural land. It also shows the percentage area of flooded agricultural land according to stagnant flood depth during SIDR. Flooded agricultural land in the study area is shown in the previous map. The quantities of this land are 252.04 sq km which are 86.70 percent of the total agricultural land. Among the flooded land medium flooded agricultural land is the most dominating category gradually followed by deep and shallow flood depth. In contrast the two vivid maps assess the displaced agricultural land. First map illustrates agricultural land before SIDR and second map illustrates displaced land after SIDR.

Table 6. Year Wise Depletion of Agricultural Land and Price Defection

	Income (thousand)	Income From Agricultural Production (%)			
		Current Income	Before 2 years	Before 5 years	Before 10 years
Landless N=20	1-5	*	19	23	27
	6-10	*	7	5	6
	11-15	*	2	3	4
	Over 15	*	1	2	1
1-10 katha N=15	1-5	3	6	13	12
	6-10	2	6	7	9
	11-15	3	4	9	16
	Over 15	1	2	7	6
11-20 katha N=20	1-5	4	5	7	9
	6-10	5	7	16	9
	11-15	3	4	11	6
	Over 15	1	3	7	3
Over 1 Bigha N=25	1-5	7	11	9	3
	6-10	2	7	16	9
	11-15	1	4	11	6
	Over 15	1	3	7	3

Source: Field Survey, June, 2011

The relationship between agricultural income as a proportion of total net income and land size spectrum is depicted in Table 6. It is estimated that among the farmers had income ranged 1-5 thousand taka are now landless with current zero income from agriculture, but constituted 27 percent, 23 percent and 19 percent of agricultural income before 10, 5 and 2 years respectively. Similarly, the farmers had income ranged 11-15 thousand taka are presently landless with zero income from agriculture, but constituted 4 percent, 3 percent and 2 percent of the same before 10, 5 and 2 years respectively. In fact, there are many aspects of climate to which prairie agriculture is vulnerable; drought[3] can inflict the most extensive damage. In third portion of Table 6, the farmers having land range 11 to 20 *katha* had income ranged 1-5 thousand taka constituted only 4 percent income from agriculture, but it was 5 percent, 7 percent and 9 percent of agricultural income before 2, 5 and 10 years respectively. Similarly, the medium farmers having 11-20 *katha* land, the current income from agricultural land ranged 6-10 thousand taka and was only 5 percent of it, but the figure was 7 percent and 16 percent and 9 percent before 2, 5 and 10 years respectively. Thus, it is evident that frequent disasters like flood, cyclone, drought, and high temperature significantly reduced the income from agricultural land over the years.

[3] Drought is defined as a long period of abnormally low rainfall, especially one that adversely affects growing or living conditions.

Table 7. Land Uses at Risk during Different Natural Disasters and Vulnerability Score

Land Uses	Vulnerability Rank				
	Non Vulnerable	Less Vulnerable	Medium Vulnerable	High Vulnerable	Total
Agriculture (Sq. Km)	38.67 (13.30)	63.98 (22.01)	121.58 (41.82)	66.48 (22.87)	290.71
Settlement (Sq. Km)	27.98 (47.78)	14.68 (25.06)	13.82 (23.60)	2.08 (3.55)	58.56
Road (KM)	134.72 (21.26)	160.12 (25.27)	259.58 (40.96)	79.3 (12.51)	633.72
Infrastructure (No.)	64.0 (16.89)	104.0 (27.44)	149.0 (39.31)	62.0 (16.36)	379
Homesteads (No)	30470 (47.89)	15967 (25.09)	14949 (23.49)	2245 (3.53)	63,631

Source: Field Survey, June, 2011 (Figures in parentheses indicates percentage)

Table 7 shows the final portrayal of the physical damage occurred by the delineated flood level according to vulnerability phase. It displays that during AILA most of the areas became flooded by different vulnerability level. It is evident that most of people and households remained flood affected and most of the damages occurred in medium vulnerability level.

4.4 DISASTER EFFECTS, WATER LOGGING AND LAND USE CHANGE

Water logging during post disaster period is responsible for land displacement. Due to water logging, a huge change has occurred in agricultural and shrimp cultivable land. Table 8 reveals that in 1985, the average land for homestead was around 7.5 *katha* and in 2009 it declined to 6.8 *katha* with a standard deviation of 4.6 and 3.6 respectively. When water logging affects homesteads, the waterlogged land is used for shrimp cultivation purpose. The standard deviation of land for homestead is decreasing which states that the gap between high and low land is decreasing. Due to water logging, larger homestead are squeezing day by day and it is used for shrimp cultivation purpose. Those households which have large areas of residential lands are now utilizing a part of their residential land for shrimp cultivation purpose. So the average area and standard deviation of homestead is decreasing.

Table 8. Land Use Pattern from 1985 to 2009

Land Use	Change in Land Area over the Decades (in *katha*)					
	1985		1995		2009	
	Mean	SD	Mean	SD	Mean	SD
Homestead	7.49	4.60	7.18	4.44	6.87	3.62
Agricultural land	37	66.19	28	54.53	22	27.76
Shrimp cultivation land	0	0	19	31.13	46	56.77
Others (Fellow land, etc)	26	65.84	17	42.71	8	29.59

Source: Upazila Land Office, Sarankhola: Data collected in 2011

Table 8 summarizes the land use change over the past 2 decades (1985-2009). It was found that in 1985, an average of 37 *katha* lands were classified as agricultural land, it decreased to 28 *katha* in 1995 as compared to 22 katha in 2009. It is evident from the observation that much of the low lying land is flooded by river water, although lower parts of the land submerged by rainwater under monsoon season. Because of this flood, the land area is subject to water logging which disrupt normal cropping patterns. For this reason, rice cultivable land is decreasing and shrimp cultivable land is increasing in the waterlogged areas. In 1995, the average shrimp cultivable area was 19 *katha*. Due to water logging the average shrimp cultivable land area in 2009 increased to 46 *katha*. The average shrimp cultivable area is increasing because it is suitable to

practice shrimp cultivation in the waterlogged areas. Comparison between the standard deviation of shrimp cultivable land is increasing which proves that there is a variation among the land size. For example in 1985 no land was used for shrimp cultivation, and so the standard deviation of land size used for cultivation was zero, but it increased to 31.13 in 1995 and to 56.77 in 2009. This increasing standard deviation reveals that land size variation used for shrimp farming is widening over the years. The fellow lands are now used for shrimp cultivation purpose. For this reason, the average area of fellow land is decreasing.

4.5 SEASONAL CROPPING PATTERNS AND THEIR ASSOCIATION WITH NATURAL DISASTER (FINDINGS FROM FGD)

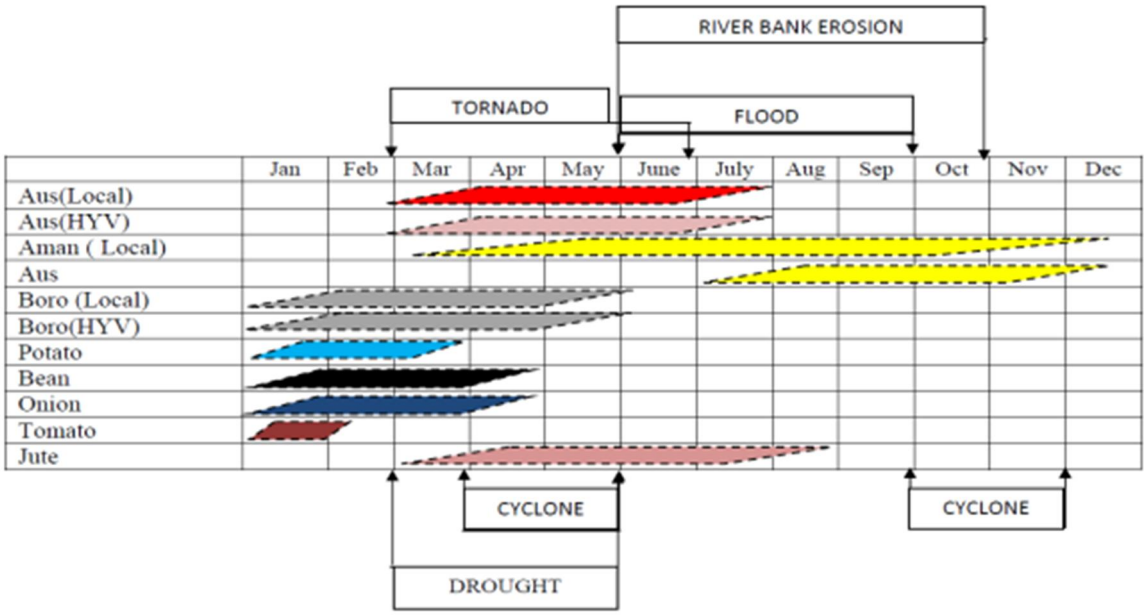

Fig. 2. International Journal of Innovation and Applied Studies

The figure shows that the growing seasons relate to seasonal flooding, tropical cyclone, drought and major kinds of natural disasters. In the study area most of the land produces three crops in a year. The figure illustrates that cyclone occurs in the pre monsoon season, mainly affects *Boro* and Aus as well as *Aman*. Jute is also a remarkably affected crop due to cyclone and drought. In addition, one or two weeks after a drought, cyclone occurs; particularly in the pre-monsoon season this region normally becomes flooded from the river water, and the flow of river water occurs more frequently, sometimes several times in a year. Seasonal flood (from April-May) generally causes most damage when the *boro* rice crop is grown. Obviously this process is a dilemma for double loss of agricultural land and further lead to long term abstention from cultivation promoting people for large scale permanent outward migration for securing alternative income.

The participants of FGD used the word *tufan* to describe cyclone and *ban* to describe flood. When they were asked about SIDR almost everyone replied that it was not a cyclone, it was *kayamat*[4], a *gazab*[5] for us. Some survivor of SIDR expressed their feelings that we miraculously survived and Allah saved us.

In response to a question about seasonal cropping pattern**, a 66-year-old man** who worked as share cropper **stated**:

Aus paddy ranked first in the cultivated area among the three types of rice. The seasonal calendar of Aus paddy is from March to July, *Aman* paddy from March to November, and *Boro* from January to May and evidently the greater possibility of the seasonal risk of tornado, flood, river bank erosion, cyclone and drought is during seasonal cropping time. Therefore, away from 3 years after SIDR I got significant drop in production due to increased salinity intrusion. Small farmers like me cannot

[4] *Doomsday or day of reckoning*
[5] *Curse of Allah*

change land use further because of lack of capital. Last year my only son Rahman (28) has gone to Dhaka for job still he did not return. I am waiting anxiously for his return.

Another 75 years old male stated the following:

In particular yield disparity has been recognized to high temperature during the *Aman* season and the crucial problem is infestation of pest insect and disease and their changes.

During the discussions, almost all participants agreed that, permanent loss of land leads to unemployment distinguished by its long or temporary duration, a significant loss of long-term earnings potential. Surprisingly enough it was reported by the discussion group that the inhabitants did not left their lands not for any intrinsic value it had, but purely emotional reason because this ownership of land mostly achieved through their descendent.

Female participants were asked to explain the land displacement, almost all the female participants reported that even at short timescales they are stigmatized to their livelihoods because of flood, drought, soil erosion, desertification, deforestation and other environmental problems. In addition female respondents perceived that due to frequent disasters cropping activities are reduced, shrimp is replacing crops in the field. While vegetables cannot grow due to saline water, the local women are hardly related with shrimp farming as traditionally women cannot contribute in earnings which ultimately reduced the economic activity of women and their mobility. A 45 year old woman stated that she had land which now turned to flooded arable land, she can neither cultivate water-logged fields nor can change land use in physical properties, so her 2 daughters migrated to Dhaka and working in a garments factory to bear family expenditure for last few years.

5 CONCLUSION

The foregoing analysis demonstrates that over the years the rate of landless households increased alarmingly due to frequent disasters such as floods, cyclone, and land erosion which significantly caused the declining availability of land. Similarly the number of petty land owners increased significantly, while the medium and high land owners decreased over the years. The surveyed data demonstrate that frequent disaster in every year compelled the farmers to sell their land consistently because these displaced lands became unusable due to its excessive salinity and long time water logging. Consequently life, livelihood and occupation of these vulnerable people were widely affected and force them to outward migration especially towards urban areas.

Future projection reveals that about 63 million and 78 million people will be displaced by 2015 and 2020 respectively [8]. The dire prediction is that a large number, closer to about half of the total population will be displaced by 2020 that reveals the extent of fatality of displacement. Hence sustainable mitigation strategy must be integrated into the development plans to address the issues of climatic displacement.

6 RECOMMENDATION

- We have to mainstream the climate change adaptation strategy into natural disaster policies and programs focusing on land displacement. With this end, in assessing the damage and compensation for the displaced people, the long term impacts of the disaster should be taken into account.
- Rehabilitation should include different measures for income and employment generating activities for the displaced population.
- Flood forecasting and early warning system should be made effective, and crop calendars should be kept up-to-date along with special methods to be used to grow seasonal crops after disaster.
- Saline tolerant and heat resistant, less water-requiring and short rotation crops should be invented for the coastal areas,
- Arable and fellow land should be conserved and alternative livelihood adaptation practice for coastal people such as cultivation of vegetables on floating beds of water or cultivation of beans, gourds and other vegetables on embankments surrounding should be adapted.

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