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ADEQUATE CONSULTATION AND DIALOGUE WITH LOCAL COMMUNITY; KEY ENTRY POINTS FOR PEACE AND DEVELOPMENT; EVIDENCES FROM SOUTH OMO ZONE

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ABSTRACT

The paper argues that adequate consultation and public wide dialogues at the grass root level are the two potential entry points in times of development interventions. This will foster peace among the nearby people and led a foundation for the subsequent development. The study was undertaken to examine whether the agropastoral communities of South Omo zone were jeopardized as a result of the OmoKuraz Sugar development project or not. It also targeted whether there was adequate consultation with the local people at the earliest days of the project. The study employed Ethnographic design, adopted the notion of rights based approach(RBA) framework in to consideration and used primary data collected through participant observation, focus group discussion(FGD) and key informant interview(KII). It indicated that there were attempts to consult the indigenous people, though not adequate. It also indicated that despite the absence of compensation for the local displaced people due to their mobile life, the people were not endangered as a result of the project. Established at the communal land of the agro-pastoralists, the Omo Sugar Development Project (OSDP) is providing training for the nearby people to offer employment security. Despite the claims of the various oversees institutions propounded as if the agro-pastoral communities were miserably suffered from such a project, the people consider it as if it is their own project. The study implied that South Omo zone is a counter example of how local level consultation and a wide range of dialogue are indispensable preconditions to foster peace and development in many pastoral and agro-pastoral areas of the country.

Keywords: Consultation, Dialogue, Villajization, Omo Kuraz Sugar Dev.t Project, Development

1. INTRODUCTION

1.1 Background Information of the Study

The potential Sources of conflict in South Omo zone could be observed emanated from four dimensions, namely the Omo-Kuraz development project, benefit sharing with Omo-Kuraz, villajization of the pastoralist community and the subsequent pastoralist grazing lands. With regard to the Omo-Kuraz sugar development project, the DAG mission, in its 2014 argued that attempts were made to engage the communities and consider some of their feedback. This was followed by the report of the DAG mission 2016, and saw little improvement by Government to undertake meaningful participatory consultations with communities, improve communities' stakes in discussionwhere land acquisition occurs, or to inform communities of the assessments. With regard to benefit sharing from the project, the local communities have a sole right to have a fair benefit from the nearby development project as it will affect their life. Despite some encouraging beginnings, however, much is left to be done to train and employ the people in the various offices of the project. Concerning the villajization project, the government's development intervention in South Omo zone is following a "two-track" villagisation process. The Omo-Kuraz plantation associated villagisation started in 2012 has already affected the peoples of Bodi, Mursi and Nyangatom areas. The second tracksupports "water-centred development" and is primarily in Dassanech, Nyangatom and Hamer woredas. Much of the issue with regard to the pastoralist grazing land, however, is debatable. The Zonal administration, in its turn, stated that adequate grazing lands will be preserved for community use and there are no any potential dismays as such. In Salamagoworeda too, the local people reported that they continue to have access to their grazing lands. Such communities in Hamer woreda, however, stated that they have already lost grazing land todevelopmental projects, and it seems a bit sound. Thus, the expectation is that inter clan conflict could also intensify as pressure increases on remaining rangelands, and as trade-offs become clearer between the requirements of commercial farms, the Omo-KurazPlantation and existing rangelands.

1.2 Statement of the problem

In the Southern parts of Ethiopia, "conflicts now cause high numbers of human death, damage to assets, displacement and migration, poverty and greater dependence on food aid" (Asnake et.al, 2013). As groups of people whose livelihood is solely dependent up on livestock production with cultivation of crops, land is many things for pastoralists and agro-pastoralists. The loss of land translated to massive decreases in the numbers of their livestock, which forced many people to adopt alternative livelihood strategies: cultivation and fishing. Despite the existence of plethora of conflict related claims by local and foreign institutions, evidence based empirical study is badly available in South Omo zone. The most "blamed" groups among the multitude of

ethnic groups in South Omo zone are those of the Bodis (Tewolde and Fana, 2014). They resorted to both projects (OmoKuraz Sugar Development Project and Villajization), for the very reason that they have little or no experience in sedentary way of life; most of them are pastoralist, and few of them are agro-pastoralist. The implication of these two projects is that they will lose their grazing lands and will result in the reduction of herd sizes. In the later days of the project (Omo Sugar), however, they surrendered for the continued dialogue, and agreed on the demarcation of grazing lands.

1.3 objectives of the study

The study has the following specific objectives.

- 1. To examine whether the agro-pastoral communities of South Omo zone were jeopardized as a result of the OmoKuraz Sugar development project or not.
- 2. To ascertain whether there was adequate consultation with the local people at the earliest days of the project.
- 3. To examine whether the rights of indigenous people were compromised as a result of the existing development interventions.

CHAPTER TWO

A CRITICAL REVIEW OF CLOSELY RELATED LITERATURE

2.1 Conceptual Framework

The term development refers to different things for different people; for AmartiyaSen, it is about the expansion of choices and freedoms; for Dennis Gullet, it is about the fair distribution of goods and services and the subsequent betterment of life thereof, and according to IDMC (2010), it is a collaborative approach "where communities contribute to developmentprocess by giving up their land, they have not only a right to just compensationbut also to receive an equitable share of the benefits."

Based on the claims of IDMC (2010), Mossissa in his 2012 publication argues that there must be adequate consultation which allows the indigenous people to participate meaningfully in all parts of the process, including the planning phase, that are relevant to their lives. His work further emphasizes that the state must obtain communities free and informed consent in accordance with their customs and traditions if adevelopment or investment project will have a major impact up on them.

This work and others underscore the need to consult local people and did not refuse undertaking development in pastoral areas. Thus, so long as it coerces people in a way that does not keep the traditions, ways of life and interests of indigenous people, the natural resource should be exploited for the transformation of the local people in particular and the GDP of the nation in general. In the context of South Omo zone, villegization is sought to be the development model, as the local people are scattered and lead mostly mobile life. Villegization models, however, entertains a wide range of criticisms from different scholarly works on the ground that it is associated with the minds of policy makers (Guyu, 2012; Yimer, 2015). The notion of villajization in some other scholars work is appreciated; Mhando, 2011, for instance argues that rural development is rhetoric without the establishment villegization programs.

Much of the debate observed, however, lies on the notion that could pastoral life systems be sustainable in this era, characterized by frequent hazards, drought being the most responsible factor for the death of thousands of livestock in the low lands? That is a question of survival and not a question of identity, ways of life, traditions, etc. That is why policy makers underscore, the villegization scheme as a development model that could be sustainable. As there is a strong nexus among the rights of indigenous people, villegization and development, the issue worth to note here is how to undertake villegization? Should it be always accompanied by consultation? What if the indigenous people refused to do so? Should the development project be sluggish as a result of the disagreement? Will not be there a tendency for violent conflict? And what prospects will be there at the post conflict setting? All these questions pose significant challenge for promoting development in pastoral areas, as the indigenous people are preoccupied with the mindset that only the size of herds determine their survival and not quality. With the few exceptions of transformation to agro-pastoral system, they are skeptical of sedentary way of life (Yimer, 2015).

2.2. Theoretical Framework

2.2.1 Rights Based Approach

A Rights-Based Approach to development puts the protection and realization of human rights at the centre. It uses established and accepted human rights standards as a common framework for assessing and guiding sustainable development initiatives. From this perspective, the ultimate goal of development is to guarantee all

human rights to everyone. This approach to social policy starts from poverty alleviation as merely a development issue to poverty eradication as a matter of social justice and dignity and from state-centered approach to participatory, multi-actor approaches involving media, corporation, communities and individuals.

2.2.2 Poverty and Development in a Rights-Based Approach

A Rights-Based Approach holds the notion that a person for whom a number of human rights remain unfulfilled, such as the right to food, health, education, information, participation; is a poor person. Poverty is thus *more* than lack of resources – it is the manifestation of exclusion and powerlessness. In this context the realization of human rights and the process of development are not separate. On the contrary, development becomes a sub-set of the process of fulfilling human rights. In this case, far from being antithesis, development could be taken to be an instrument for the realization of human rights. The establishement of the various agribusiness development projects in the various low lands, including the South Omo Sugar Development project, is therefore, part of an effort to alleviate poverty.

2.2.3 Basic Assumptions of the Theoretical Framework

Among other things, the rights based approach (rba) is founded on the following basic assumptions. It;

- Considers the redistribution of the existing resources
- Using participatorymethods actively engage rights-holders in influencing, designing and monitoring education policy and delivery, ensuring that complex information is translated and repackaged to make it more accessible at the grassroots.
- Violations of rights are taken as the starting point, which leads in to analysis, and actions at the structural and macro levels.
- > Has a tendency to work more with people whose rights are most violated or denied.
- Caries legal force to development work
- > Helping people to restore their dignity by claiming their rights as human beings and citizens

Theoretical Explanations of the problem in the study area

As far as the notion of the theory considers the *redistribution of the existing resources*, the reality that the Sugar development projects are not targeted at collecting wealth at the expense of the indigenous people in South Omo zone. The intention of the state is simply to create a mutual environment which endorses the juxtaposition of development and the rights of the people in the area. In this regard, the establishment of the Sugar Development projects entails expansion of opportunities to work, in the first place, for the people in the area. In addition to its contribution in terms of job creation, the factories indirectly will support the local livelihoods in terms of forage production for their livestock from the factory bi-products. This intern will enable the local people to adopt better livelihood strategies in keeping quality of their livestock and for better marketing values. Moreover, the establishment of these projects necessitated the construction of several networked roads in the area, allowing the local people to have access to markets.

Secondly, the theory of right based approach demands to useparticipatorymethodsto actively engage rightsholders in influencing, designing and monitoring education policy and delivery, ensuring that complex information is translated and repackaged to make it more accessible at the grassroots. This notion of the theory is emanated from the context that, if people are aware enough about, the project concerning its undertakings, causes, consequences and implications through an open and frequent dialogue, they could be potential owners of the project. The people, far from being pessimistic about the project, they will allow to undertake it sometimes at their own risk, if they are fully consulted and genuinely informed prior to the official launch of the project.

On the other hand, the rights based approach asserts the notion that *violations of rights are taken as the starting point*, which leads in to analysis, and actions at the structural and macro levels. The violations which will occur as a result of development interventions could range from displacement to that of security threats. The key point here is that every society is skeptical to change. In most cases, the first days of the development intervention are usually unfavorable accompanied by fear and suspicion among the state and the local people. Situation may call up on the state to utilize force to keep peace and order. Initial and frequent works in making people aware about the probable effect of the project on their life, and the adequate compensations thereof, are primary obligations of the state. It should also be noted that the people should be consulted and fully informed that the project will result primarily in the improvement of their life in many ways. In this case, the people will tend to calculate the

incoming macro gains for relatively small economic costs. This comprises the structural analysis part of the result of the project on the lives of the local people.

In addition to the issues discussed above, the rights based approach envisages quite important issue that there should be a tendency on the part of the state to *work more with people whose rights are most violated or denied*. People may get their rights violated in the form of displacement from their valuable lands, which they see them vital for cultural, economical and psycho-social reasons. The project should provide priority for revitalizing the people in this setting in the first instance. The constitution and other laws of the state strongly underscore the mandatory nature of adequate compensation. This entails a compensation which is commensurate with the economic costs incurred as a result of the impact of the project. Some of the literature, emphasizes however, this may not be necessarily paid in cash, rather should come in the form of empowerments in the long run.

Finally, the rights based approach theory emphasizeshelping people *to restore their dignity* by claiming their rights as human beings and citizens. So long as the mission of development is concerned, people are not instruments to be manipulated. After all, the aim of development is to get choices available and make people lead qualitatively better lives. In this regard, development could be conceived as a war against poverty, to make people declare their independence from the chronic arena of poverty's colonialism. The development intervention, therefore, should aim not only to restore the previous dignity of people in the area, but also to construct and reconstruct a better identity and dignity.

CHAPTER III

3. METHODOLOGY

3.1 DESCRIPTION OF SOUTH OMO ZONE

The South Omo zone is located in the Southern Nations, Nationalities and Peoples regional state. It accounts to 24,249 km2 of the total area of the SNNPRS. The Zone has eight *Woredas* and the Jinka town administration (the Zone Capital). Sixteen ethnic groups are considered indigenous to the Zone, while a considerable number of people fled from other parts of the country also live there. According to the population projections for 2016/17 based on the population and housing census conducted in 2007 (Central Statistical Agency, 2008), the Zone has a total population of 767,915. With regard to economic activities, pastoralismis the main provider to the mobile and semi-sedentary communities in the Omo Valley of Ethiopia. It sustains the lives of people and their livestock in this fragile, conflict prone and largely neglected region. Livestock are not raised with market considerations, but both in times of need and for goods like food and clothes, agro-pastoralists sell livestock. In addition, all pastoral groups have exclusive or negotiated access to river banks, and engage in flood retreat agriculture. For most ethnic groups in South Omo such cultivation is practiced along the Omo River, while some use Mago and Woyto.

3.2 Research Design

The study is qualitative cross sectional study based on Ethnographic design. The research design is purely descriptive depending on the nature of the issue. Most recent studies undertaken in such topics as pastoralism, villegization, consultation with indigenous people, land acquisitions, etc, used qualitative approaches.

3.3 Sources of Data and Data Gathering Instruments

The study employed mainly primary data and secondary ones to some extent, where relevant. Specifically, participant observation, focus group discussion with the officials of OmoKuraz Sugar Development project, and key informant interviews with selected leaders of the villages, were used to collect the relevant data.

3.4 Data Analysis

The collected data were transcribed and lightly edited for coherence. The concerns raised during the interview and focus group discussions were carefully presented and triangulations were made.

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

This part of the paper discusses the data collected from key informant interview, focus group discussions and triangulated with the insights of field observation undertaken over the period of two months in South Omo zone. The following key informant interview provides a situation where discussion will win the interest of groups and only this discussion and consultation is viable than forced displacement.

The villegization program and the Omo-Kuraz Sugar development projects brought challenges to our lives in that both of them are responsible for destruction of traditional communal land ownership systems, loss of grazing, limited amount of animals, low or reduced production of milk, reduced income, low resilience capacity, etc. We don't think that these two projects will benefit us greatly, but what options do we have other

than claiming these are our lands. The government, in the various pastoralist days, however, promised many things that will improve our livelihood particularly up on the completion of the Sugar project. Although we were pessimistic on the villegization and Sugar project, what made us to agree is that they (government bodies) frequently informed us we will be employed in the sugar plant, schools, health centers, etc, will be available and we agreed.

As the above discussion indicates, though there were dismays on the two projects, particularly, in relation to their pastoral life, with regard to communal land ownership and the subsequent effects on their lives, they indicated that frequent dialogues between the local people and the government resulted in an agreement. As the key informant clearly indicated, land is everything for pastoralists. Through land, they will have an opportunity for grazing and enlarge their livestock. Above all, the survival of indigenous peoples intrinsically linked to the survival of their territories, mostimportantly land and land-related resources (Young, 2010).

Thus, the local people requested the zonal administration to demarcate some grazing areas in the oasis areas. The zone also responds positively and this created a fertile ground for agreement, peace and development.

The focus group discussion which was held among the authorities of the OmoKuraz Sugar development project on the duty of the state to consult the indigenous people indicated that there were dialogues and consultations.

We believe that the local people shall participate in the formulation, implementation and evaluation of plans and programs for national and regional development which may affect them directly. And we did this in the varied intervals since the inception of the project. We informed them as the project is of their own in the sense that it will create temporary and permanent employment opportunities to them. Moreover, the project will provide forage for their livestock and will empower the nearby people through income diversification activities.

Concerning the existence of consultation, the existing literature indicated that there were rooms for consultation and dialogue among the local people. In this regard, Ayele (2015) clearly indicated that "*project has employed public consultation*

with mass participation at various-levels through Steering Committees organized to facilitate and conduct public dialogue, follow up and monitor the project activity, and plead with the local community over the development ventures." It also explained the fact that, "despite the minimal role of the local communities in agenda setting", the consultation process "established efforts in mass mobilization, soliciting local support and creating social services. However, the process narrowly viewed consultation as participation."

The second issue of the focus group discussion was on the impact of the OmoKuraz Sugar development project on the livelihood of the nearby pastoralist communities. The content of the discussion is stated here under.

The project will not have any externality up on the lives of the local people. To this effect, we have conducted impact assessment projects. These impact evaluation results informed us the impacts are positive. The OmoKuraz Sugar development project, therefore, was accompanied by scientific and rigorous impact assessment projects.

Although the focus group discussion result tried to inform us that there were no negative impacts up on the lives of the local people based on the results of impact assessment programs, the latest literatures stand to refute the concern of the authorities. Ayele (2015), for instance, argued that "The project has abrogated communal land title and traditional land administration; restricted access to the river, biodiversity, wild food and environmental interaction; marginalized pastoralists from their spiritual, cultural, social and economic tie with their traditional lands; and transformed pastoralists into a sedentary livelihood."

The key informant interview, in its turn, indicated that they were not negatively affected by the project, and they are rather started to live in a defined village which is accompanied by social services. Some of our members are employed as guards in the project, while some others were trained and working in food production activities in the enterprise. The informant added that as a pastoralist community, we were living a mobile way of life, which had been subject to frequent drought, animal death, food insecurity, flood, and other disasters. Now, as a result of villejized life which came in to effect partly due to this sugar project, our life is institutionalized. We get protection, health centers, water, and education for our children, etc.

Thus, despite the dismays of the researcher, Ayele's 2015 publication failed to include scientific environmental impact assessments that inform whether the project really affects the local people negatively or not. Moreover, the concerns of the study are only from anthropological point of view. Therefore, based on the claims of the key

informant and the results of the focus group discussions, it is valid to deduce that there are no clearly observed negative externalities of the project on the lives of the local people.

The other part of the key informant interview was on the villegization program in South Omo zone, particularly in Salamago district, where the sugar development project is taking place. The question posed was on whether the villegization program was started as a result of the Kuraz Development project or not and whether that was voluntary, based on consultation and extended dialogue with the nearby people.

Villegization is not a new phenomena and is not strictly linked to the OmoKuraz Sugar development project, as it has already been started earlier in different woredas of South Omo zone. It was proposed, according to the authorities, to make us (the scattered pastoral people) resilient from the drought schocks. The process of villegization was not as such coercive, as there were discussions with us, but there were no genuine responses for raised questions from the people. The authorities will dictate sometimes, indicating that the villegization project is inevitable as it was directed from the federal government. Therefore, it lacks some sort of flexibility. The sugar project, despite taking our grazing land, is not disastrous.

As it is clearly stated above in the discussion, one can see that the villegization program is not initiated as only a result of the sugar development project, rather due to extremely variable natural hazards such as drought. The existing literature also could indicate this claim. According to the study by Tewolde and Fana (2014), the villegizationprogramme in Salamago*Woreda*at the planning stage is not particularly associated with the Kuraz Sugar Development Project, but the needs of the project seem to have accelerated the pace of implementation. The other thing to be noted, is whether the villegization program was voluntary, accompanied by consultation, or was /is it accompanied by coercive measures? In this regard, diverging views have been reflected from the various bodies. Some of the literature provided us with top down approach and somewhat forced(Yimer, 2015; Ayele, 2015), while others observe it as using pulling strategies like availing social services and infrastructures(Fana and Tewolde 2014). Still some others claimed that pastoralists were forced to move to villages and were accused of being anti-development(Oakland Institute, 2015) for the reason that they resist the land grab practices.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Most of the struggles exerted to protect the rights of indigenous people while not infringing development endeavors revolvearound the protection of lands, territories and resources against expropriation by the state, by corporations by the dominant populations. Integral to this struggle is the assertion that traditional political, economic, social, cultural and spiritual systems of the indigenous peoples be respected. What is clearly stated in South Omo zone along with the trajectory of contemporary development is the issue of development with identity and culture. The central point of the assertion is that indigenous peoples have the right choose their own ways of life, their values of solidarity, reciprocity amongst themselves and with nature, manifested their spiritual and cultural relationship with their lands and waters, should not be destroyed by so called development. However, leaving the development of the vast fertile oasis areas unexploited could not be any more viable. Therefore, in an attempt to make the local people beneficiary from the nearby development must follow bottom –up approached and should be based on the genuine participation of the community under discussion.

5.2 Recommendation

The indigenous people in South Omo zone are leading pastoral and agro-pastoral life, and exploit the vast communal lands for their grazing. The aforementioned development interventions, particularly villegization and the Omo-Kuraz Sugar development project, brought some fundamental changes up on the ways of lives, economies, institutional set ups of these somewhat mobile people. Now, they start to lead a settled life, with limited access to grazing and better access to water. In such settings, extended dialogue and more meaningful participation of the people should be in place so as to overcome a potentially combustible conflict from increased competition for scarce resources. This should be really meaningful consultation with the region's indigenous groups, reflecting their unique situation and needs, and respecting their right to give free, prior, and informed consent before their land is used, as stipulated by the country's constitution.

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SURVEY OF MENTORS' ROLES IN GUIDING AND SUPPORTING NOVICE TEACHERS IN DANGILA DISTRICT ELEMENTARY SCHOOLS, ETHIOPIA

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ABSTRACT

The purpose of this study was to assess the roles and responsibilities of mentors in guiding and supporting novice teachers in primary schools of Dangila district. In doing so, an attempt was made to answer the basic questions; Do mentors guide and support novice teachers effectively? What are the conditions that affect the mentoring relationship between mentors and novice teachers? Is there a healthy relationship between mentors and novice teachers? And what are the major problems facing to novice teachers? The method used to conduct this study was descriptive survey. 14 primary school in Dangila district were selected using simple random technique. Before dispatching the questionnaires, pilot test was conducted and proved by using alpha coefficient. Its' internal consistency was 0.85. Mentors, novice teacher, and principal respondents were selected randomly to fill out the questionnaire properly. Data gathered from 33 mentors, 63 novice teachers, and 14 principals were analyzed and interpreted. Furthermore, portfolio of novice teachers and information obtained through observation were incorporated. The findings of the study indicated that mentors did not guide and support novice teachers effectively, although mentors seem good in knowing their roles and responsibilities. Absence of training, shortage of time and logistic, lack of interest, few number of experienced teachers in remote schools and absence of planned regular meeting were identified an crucial factors that affect mentoring relationship. The relationship between mentors and novice teachers was found good. Accommodating students' difference, in- effective evaluation, and absence of well developed content knowledge were identified as problem facing the novice teachers. Providing mentoring training, encouraging experienced teachers to retain in the remote schools for longer years, appropriate support by district expert and sharing experience from experienced teachers are some of the possible solutions.

Keywords: Mentoring, Mentors, Novice teacher, Guiding and Supporting, and Elementary school

INTRODUCTION

At all stages of teacher education and in many countries of the world, mentoring is an acknowledged part of learning and developing new skills. Given the current pressure for educational reforms, mentoring can be an effective way to train teachers to adopt new practices (Weaver, 2012). Professional development practices such as mentoring that provide one-to-one guidance and ongoing on-site support can become successful because learning depends on the collegiality among teachers. A scene of collegiality also makes less experienced teachers feel safe to make mistakes, study themselves and share learning with each other to create excellence in their delivery (Dantonio, 2009). The support for mentoring in teacher training is relied for supporting novice teachers in keeping up with the constant demands of new educational reforms that require them to adopt new practice (Weaver, 2004).

According to the Ministry of Education (2010) in Ethiopia, a mentor is an experienced practitioner who provides professional guidance and support. Similarly, Donaldson (2008) defined a mentor as normally a more experienced colleague with knowledge of the needs and professional contexts of other person. Mentoring is therefore, the process by which experienced teachers give support, motivation and any other help when necessary to someone less experienced. It is also a method that helps newly employed teachers(novice) to set goals and strive for their success by having the necessary knowledge, skills, and attitude (MOE, 2010). It is a means of support offered by a staff member or colleague with more experience in the profession to another staff member who is with little experience.

Teachers who are new to the profession often experience stress in their teaching experiences. In addition to the traditional burdens of school rules, deadlines, procedures and expectations, today's schools face many new challenges: schedules are tight, assessing students are much more stringent requirement, and teachers are busier than ever trying to keep up with new content, new technology, and new methodology(Gagen, et al.2013). Novice teachers are more likely vulnerable because they are more likely than their more experienced colleagues to be assigned to low- performing students (Gagen, et al.2013). Despite the added challenges that come with teaching children and adolescents with higher needs, most novice teachers are given little or no mentoring they have to contend with lack of professional support and feedback, and a demonstration of what it takes to help their students succeed (Anthony & Kristsonis, 2014). This shows that mentors play significant roles in providing support for new teachers as they manage classrooms.

Studies conducted in the elementary schools of Ethiopia in the last three years demonstrated that new teacher turnover rates can be cut in half through comprehensive induction that includes a combination of high quality mentoring professional developmental support, scheduled interaction with other teachers in the school and in the community at large, and formal assessment for new teachers during at least their first two years of teaching (Smith & Ingersoll, 2012). Regarding its process and careful planning in the primary school of the study area, it has been reported in different meetings, panel discussions, workshops, seminars and discussions that the mentoring process in particular, and the CPD program in general, has many problems or constraints in implementation. In fact, there is also lack of a recognized study (at least to the researcher's knowledge) that explains whether mentors are appropriately guiding novice teachers or they failed to do their responsibilities in the Ethiopian context. Besides, there is knowledge gap (lack of experience) on the status of mentors' and novice teachers' relationship during the mentoring process in Dangila district primary schools.

Mentors regarded mentoring as an important responsibility, believed they were effective in their role, and found the experience of mentoring a rewarding one. In Donaldson's (2008) study, mentors thought "they had created an appropriate balance between pastoral care and support and level of challenge for new teachers." Mentors gave clear accounts of ways in which novice teachers acted upon their support, sharing experience and were making progress in developing skills as teachers. In addition to this, mentors found it beneficial when another promoted member or staff under took an occasional lesson observation and confirmed that beginning teachers were making appropriate progress. The duties undertaken by mentors were in most cases, outlined clearly in the form of guidelines. The guidelines provided in continuous professional development manuals, helped mentors and novice teachers to develop their understanding and expectations of support strategies.

According to the (MOE, 2015 & Rhodes, 2012), mentors must possess ideals and expertise of the teaching profession, which are shared with the new teacher. The function of the mentor teacher varies depending on the needs of the new employee, the goal of the mentoring program, and the local and broader education.

It should be kept in mind that the mentor teacher is a helper, not a supervisor, or evaluator, and "a very special person, a model of professionalism". Most of the time, various literatures, books and studies related to mentoring typically describe the benefits for novice teachers. However, facilitators of mentoring programs and researchers are recognizing that mentors also derive substantial benefits from the mentoring experience (Donaldson, 2008). Teacher quality is improved by the implementation of best teaching practice. Mentoring plays a significant role in the implementation of best practices by asking reflective questions, and providing curriculum resources. Thus, for the purpose of effective mentoring to take place, the mentor and novice teacher must develop a full faith interaction and share common interests, values and goals among each other. It is not only the duty of mentors for effective interaction but novice teachers also have a great role in the mentoring process.

Being new, beginners are seldom aware of the school culture, norms, and expectations (Wildman et al.1992).They must learn the social expectations and conventions that guide daily school operations and interactions among administrators, colleagues, parents, and students. Novices often do not understand their roles in the social setting, and the mentors may have to smooth over blunders, at times putting their own reputations on the line. Even after initial training and consciousness-raising, the mentors often forgot or were not truly aware of the differences between experts and novices. Problems also arose when the beginner would not reciprocate in the sharing process. Occasionally, mentors commented that their beginners would take everything (e.g., time, materials, and ideas) and give nothing in return (Matters, 2009).Conditions that created problems for novices often related to their academic or extra-curricular assignments.

Today, mentoring has become an important topic in Ethiopian education and a preferable strategy in continuous professional development program focused on beginning teachers' induction (MOE, 2011).Besides, creating new career opportunities for experienced teachers, assigning mentors to work with and help for beginning teachers represent an improvement over the abrupt and unassisted entry into teaching that characterizes the experience of many novices. In-service training given to mentors expands the teaching role and thus improves the quality of mentoring. Holloway (2009) stated that the mere presence of a mentor is not enough; the mentor's knowledge of how to support new teachers and skill at providing guidance are crucial factors. Mentoring is likely to be of no value if mentors do not improve in their knowledge and expertise and change teaching practices to reflect current research. Similarly, (Davis, & Higdon, 2008) proposed that mentoring could only be effective if both parties are willing to grow and learn and base their relationship on mutual trust and openness.

In general, there is a growing concern among educators, whether at the national or district level, that the single most important factor in determining student performance is the quality of his or her teachers. Therefore, if the

national goal of achieving quality of education for all across the country is to be met, it is critical that efforts be concentrated on developing and training high-quality teachers in every community and at every grade level. Moreover, qualified and efficient mentors are also very necessary to help, guide, and create expert beginning teachers. Therefore, considering the importance it gives to mentors and newly deployed teachers, the researcher finds it necessary to make a study on the roles of mentors in helping novice teachers. Therefore, this study attempted to identify and describe the role of mentors, an investigation has been made to identify whether the relationship between mentor and beginning teachers during mentoring was effective or not effective. Based on the above discussions, this study aimed at answering the following research questions:

- 1. Do mentors guide and support novice teachers frequently?
- 2. Do mentors know their roles and responsibilities to guide and support novice teachers to think critically?
- 3. What are the conditions that affect the mentoring relationship between the mentors and novice teachers?
- 4. What are the major issues faced by novice teachers?

The general objective of the study was to investigate mentors roles in guiding and supporting novice teachers in Dangila district elementary schools. Accordingly, the specific objectives of the study were to identify mentors guide and support novice teachers frequently, to assess the role and responsibility of mentors, to investigate the conditions affecting mentoring relationships and to identify major problems faced by novice teachers.

MATERIALS AND METHODS

The research design of the study was descriptive survey research. This research design deals with the current state of affairs of the mentors, novice teachers and of principals about the role of mentors in guiding and supporting novice teachers.

SOURCE OF DATA

For this study, primary sources of data were employed. The primary sources were mentors, novice teachers and principals of Dangila district elementary schools.

The determination of sample schools was based on Dangila district 2011 annual Educational report. According to this report, there were 48 elementary schools. Of these, 26 Elementary schools were without novice teachers and the remaining 22 elementary schools were With novice teachers. So the researcher selected 22 elementary schools as a target population for this study. From these 22 elementary schools, 14 (63.6%) schools were selected by simple random sampling. Simple random sampling technique gives an equal chance for all the study population. Why 14 schools were selected? Because the 14 schools can be above 50% and representative for the study population.

All the teachers who had three years and above experience and who were assigned as mentors and all the mentees were the respondents of this study. Therefore, 42 mentors (30 males and 12 females) and 68 novice teachers (27 males and 41 females) were selected by comprehensive sampling technique since the number of teachers was manageable. In addition 14 school principals (13 males and 1 female) were selected from the sample schools as the already selected schools were 14.

DATA GATHERING INSTRUMENTS

The main data gathering instruments of the study were close ended and open ended questionnaires. Interview and observation were used to supplement the information obtained through the questionnaire. The questionnaire was prepared in a likert scale such as strongly agree- agree-undecided-strongly disagree-disagree. The mentors gave responses regarding the novice teachers while the novice teachers were responding questions about the mentors. Two sets of questionnaires were developed by the researcher:

1. The questionnaire for the mentors contained 45 items, designed to obtain data about conditions that affect mentoring relationships, major problems facing novice teachers and to check the presence of healthy relationships between mentors and novice teachers. These were based on the procedure of data administration that mentors communicated with their mentees to obtain empirical data from respondents.

2. The second questionnaire was prepared for novice teachers, having 35 items designed to obtain information about effectiveness of mentors, role and responsibility of mentors, conditions that affect the mentoring relationships and the degree of healthy relationship. These were based on the novice teachers' responses they participated in which mentees reply.

Reliability of the questionnaire was determined by alpha coefficient and it was 0.85 for effectiveness of mentors, 0.88 for the role and responsibility of mentors, 0.77 for the conditions that affect mentoring relationship, 0.83 for health relationship, and 0.86 for the major problems faced to novice teachers. Reliability of the questionnaire was calculated after pilot study conducted outside the sample schools. That is why each research questions indicates consistency of the instrument.

DATA ANALYSIS TECHNIQUES

In the presentation and Analysis of data, descriptive statistical analysis was employed. Some of the items of the questionnaire were grouped into their categories. Data collected through structured questionnaire were analyzed using percentage and mean. Narrative description was applied for the information obtained through observation and interview to triangulate results of the data collected through questionnaires.

RESULTS AND DISCUSSIONS

This part of the paper deals with the analysis of the data gathered from sample school mentors and novice teachers in Dangila district. A total of 110 copies of questionnaires were distributed to the respondents. Of which 68 questionnaires were distributed to novice teachers and 42 questionnaires were distributed to mentors in the sample elementary schools. However, for various reasons all the questionnaires were not returned and correctly filled. The response rate was 96(87.3%). The remaining 4 %(12.7) respondents were not filled properly. Thus, 63 questionnaires obtained from novice teachers and 33 questionnaires obtained from mentors were used for this study.

3.1 Mentors Effectiveness in Guiding and Supporting Novice Teachers

| No | Items | | | Total Number of respondent | | | | | | | | | | Standard |
|-----|------------------------------------|-----|----|----------------------------|----|------|---------|---------|------|------|---|-----|------|----------|
| 110 | items | nt | | | | Nov | vice Te | eachers | - 63 | n | | | (M) | Dev. |
| | | nde | | | | | Ratin | g Scale | | | | | ~ / | |
| | | ods | | 1 | | 2 | | 3 | | 4 | | 5 | | |
| | | Res | No | % | No | % | No | % | No | % | Ν | % | | |
| | | | | | | | | | | | 0 | | | |
| 1 | Mentors possess qualities and | N.T | 6 | 9.5 | 19 | 30.2 | 9 | 14.4 | 24 | 38.1 | 5 | 7.9 | 3.04 | 1.18 |
| | abilities that you respect and | | | | | | | | | | | | | |
| | admire. | | | | | | | | | | | | | |
| 2 | Mentors have understanding of | | 6 | 9.5 | 21 | 33.3 | 14 | 22.2 | 18 | 28.6 | 5 | 7.9 | 2.87 | 1.09 |
| | instruction in the area you teach. | | | | | | | | | | | | | |
| 3 | Mentors are exemplary teachers | | 6 | 9.5 | 20 | 31.7 | 11 | 17.5 | 21 | 33.3 | 4 | 6.3 | 2.98 | 1.17 |
| | for you. | | | | | | | | | | | | | |
| 4 | Mentors show an awareness of | | 6 | 9.5 | 23 | 36.5 | 13 | 20.6 | 15 | 23.8 | 5 | 7.9 | 2.85 | 1.14 |
| | current teaching trends. | | | | | | | | | | | | | |
| 5 | Mentors demonstrate a wide | | 5 | 7.9 | 26 | 36.5 | 11 | 17.4 | 18 | 4.76 | 3 | 4.7 | 2.80 | 1.09 |
| | range of interpersonal skills. | | | | | | | | | | | | | |

| Table-1: | Mentors | abilities | to | Guide and | Support | Novice | Teach | ers |
|----------|---------|-----------|----|-----------|---------|--------|-------|-----|
|----------|---------|-----------|----|-----------|---------|--------|-------|-----|

Key: N.T= Novice teachers, strongly agree=5, Agree=4, undecided=3, Disagree=2, strongly disagree=1,

Table 1, presents mentor effectiveness in guiding and supporting novice teachers. As rated by respondents, against the mean scores(average score) were interpreted in such a way that mean scores below 3 indicated ineffectiveness of the mentor, inversely a mean score value of 3 or greater than 3 indicated effectiveness of the mentor. 39.6% of the novice teachers disagreed that mentors possessed qualities and abilities that respect and admire while the majority (46%) agreed the idea. Hence, novice teachers believed that mentors possessed qualities and abilities that respect and admire.39.6% was the sum total of strongly disagree and disagree rating scales which grouped together for the convenience of data analysis.

On item 2, of the same table, 42.8% of the novice teachers believed that mentors had no understanding of instruction while 36.5% of the novice teachers agreed the idea. Therefore, mentors had not enough understanding to support the mentees. Item 3,(39.6%) of novice teachers believed that mentors were exemplary teachers but(41.2%) disagreed the idea. Thus, Dangila district primary school teachers believed on mentors were not exemplary teachers.

In relation to item 4, the majority (46%) of novice teachers disagreed while (31.7%) of them agreed. Therefore, novice teachers in that district did not believe on mentors' awareness of current teaching trends. In the last item of this table however, (44.4%) of novice teachers disagreed on mentors interpersonal skill, (9.52%) of the novice teachers agreed upon. It seems to be true that mentors had shortage of interpersonal skill to sustain positive professional relationships.

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Mean score was used to show the effectiveness of mentoring program. In line with this, the mean score of novice teachers in item 1 was (3.04) which were above 3. In the application of mean score, the researcher did not keep to the patterns of presenting starts through percentage (%). This indicated that novice teachers in the sample schools believed on mentors qualities and abilities. For the remaining for items, the mean score of novice teachers were below 3 (i.e.2.87, 2.98, 2.85, and 2.87) respectively. This shows that mentors have less ability to support novice teachers. According to Rhode, (2012) & MOE (2013), mentors should be exemplary, have good interpersonal skills, and awareness of current teaching trend.

3.2 Roles and Responsibilities of Mentors

| | Table-2: Qualities of Mentors | | | | | | | | | | | | | |
|----|-------------------------------|------|----|------|-----|---------|------|-----------|-------|------|----|-------|------|----------|
| No | Items | t | | | | Total 1 | Numb | er of res | ponde | nt | | | Mean | Standard |
| | | lent | | | (M) | Dev. | | | | | | | | |
| | | ond | | | | | Rati | ng Scale | | | | | | |
| | | Resp | | 1 2 | | | | 3 | | 4 | | 5 | | |
| | | | No | % | No | % | No | % | No % | | No | % | | |
| 1 | Mentors serve as a | М | 3 | 9.1 | 11 | 33.3 | 4 | 12.12 | 9 | 27.3 | 6 | 18.18 | 3.12 | 1.31 |
| | professional role | | | | | | | | | | | | | |
| 2 | Mantana aamu | м | 2 | 6.06 | 6 | 10.10 | 4 | 10.10 | 12 | 20.4 | 0 | 24.24 | 2 57 | 1.22 |
| Z | critical friend | IVI | Z | 0.00 | 0 | 18.18 | 4 | 12.12 | 15 | 39.4 | 8 | 24.24 | 5.57 | 1.22 |
| 3 | Mentors are models | М | 3 | 9.1 | 8 | 24.2 | 4 | 12.12 | 12 | 36.4 | 5 | 15.15 | 3.30 | 1.28 |
| | of effective | | | | | | | | | | | | | |
| | instructional | | | | | | | | | | | | | |
| | techniques for novice | | | | | | | | | | | | | |
| | teachers | | | | - | | | | | | | | | |
| 4 | Mentors are sensitive | М | 3 | 9.1 | 6 | 18.18 | 4 | 12.12 | 12 | 36.4 | 8 | 24.24 | 3.48 | 1.30 |
| | to needs of others. | | | | | | | | | | | | | |
| 5 | Mentors are | М | 4 | 12.1 | 7 | 21.2 | 6 | 12.12 | 12 | 36.4 | 4 | 12.12 | 3.15 | 1.25 |
| | enthusiastic about the | | | | | | | | | | | | | |
| | profession | | | | | | | | | | | | | |

Key=Mentors strongly agree=5, Agree=4, undecided=3, disagree=2, strongly disagree=1

From the above table, (45.48%) mentors agreed that they serve as a professional role model, while the remaining (42.4%) of the mentors were disagreed. For item 2, (63.64%) mentors agreed that they serve as critical friend to the novice teachers. But (24.24%) disagreed on the idea. Therefore, majority of the mentors believed that mentors serve as critical friends for mentees. For item 3,(54.58\%) and (33.3%) of the mentors agreed and disagreed respectively. Hence, majority of the mentors believed that mentors were models of effective instructional techniques for the novice teachers.

From table 2 above item 4 &5, (48.5 %) and (33.32%) of the respondents agreed and disagreed respectively. Thus, most mentors were sensitive to the needs of others and enthusiastic about the profession. The mean score was used to indicate whether mentors know their roles and responsibilities .The mean score of mentors were greater than 3(i.e.3.12, 3.57, 3.30, 3.48, and 3.15 from item 1-5 respectively). This showed that mentors know their roles and responsibilities.

| Table-3: School I | Related Factors | s that Affect | Mentoring |
|-------------------|------------------------|---------------|-----------|
|-------------------|------------------------|---------------|-----------|

| | _ | | | | | | | | | | 0 | | | |
|----|---|------|----|----------------------------|----|------|-----|-----------|----|------|----|-------|------|----------|
| No | Items | | | Total Number of respondent | | | | | | | | | Mean | Standard |
| | | ent | | | | | Me | ntors=33 | | | | | (M) | Dev. |
| | | ond | | | | | Rat | ing Scale | | | | | | |
| | | tesp | | 1 | | 2 | | 3 | | 4 | | 5 | | |
| | | | No | % | No | % | No | % | No | % | No | % | | |
| 1 | Mentors get mentoring training | М | 5 | 15.2 | 14 | 42.4 | 4 | 12.12 | 7 | 21.2 | 3 | 9.1 | 2.66 | 1.24 |
| 2 | Experienced teachers are few in number at schools | М | 4 | 12.1 | 5 | 15.2 | 7 | 21.2 | 16 | 48.5 | 2 | 6.06 | 3.21 | 1.16 |
| 3 | Mentors carefully identify specific novice teachers need | М | 4 | 12.1 | 7 | 21.2 | 6 | 18.18 | 12 | 36.4 | 3 | 9.1 | 3.12 | 1.21 |
| 4 | Mentors selection is based on their personal and professional qualities | М | 3 | 9.1 | 13 | 39.4 | 5 | 15.15 | 9 | 27.3 | 3 | 9.1 | 2.87 | 1.19 |
| 5 | Mentors have planned meeting program | М | 2 | 6.06 | 12 | 36.4 | 5 | 15.15 | 9 | 27.3 | 5 | 15.15 | 3.09 | 1.23 |

Key: M=mentors, strongly agree=5, Agree=4, undecided=3, Disagree=2, strongly disagree=1

As shown from table 3, the majority (57.55 %) of the mentors disagreed about the mentoring training but (30.31%) of the mentors agreed on the idea. Regarding teachers' experience, however majority (54.54%) of the mentors agreed that experienced teachers were few in number in the schools, small number of the mentors (27.22%) disagreed with the idea. Similarly,(54.54%) of the respondents agreed that mentors carefully identified specific novice teachers learning need. Nevertheless, (33.33%) mentors disagreed.

For item 4, (48.45%) of the mentors disagreed that selection of the mentors was sought who possessed personal and professional qualities of the highest order. On the contrary,(36.37%) of the mentors agreed on the idea. Item 5, indicates that (42.42%) of the mentors disagreed that they had planned meeting program. The rest agreed on the idea. Therefore, mentors had no planned meeting program.

Mean score was used to indicate the overall condition that affect mentoring relationships. In line with this, for item 1, the mean score was below 3(2.66). Hence, mentors had not gained mentoring training. For item 4, the mean score of mentors was below 3(2.87) and hence, selection of the mentors was not on personal and professional qualities.

3.3 Challenges faced to Novice Teachers

Table 4: Novice Teachers Activities in the classroom

| No | Items | | | Total Number of respondent | | | | | | | | | | Standard |
|----|---|-----|----|----------------------------|----|------|----|-------------|----|-------|---|-------|------|----------|
| | | ent | | | | | M | lentors=33 | | | | | (M) | Dev. |
| | | nde | | | | | Ra | ating Scale | | | | | | |
| | | ods | | 1 | | 2 | | 3 | | 4 | | 5 | | |
| | | Re | No | % | Ν | % | Ν | % | No | % | Ν | % | | |
| | | | | | 0 | | 0 | | | | 0 | | | |
| 1 | Novice teachers motivate students in the classroom | М | 1 | 3.03 | 11 | 33.3 | 4 | 12.12 | 15 | 45.45 | 2 | 6.06 | 3.18 | 1.07 |
| 2 | Novice teachers accommodate differences among students. | М | 3 | 9.09 | 17 | 51.5 | 3 | 9.09 | 8 | 24.24 | 1 | 3.03 | 2.67 | 1.14 |
| 3 | Novice teachers evaluate students work properly. | М | 2 | 6.06 | 15 | 45.5 | 5 | 15.15 | 8 | 24.24 | 3 | 9.09 | 2.85 | 1.15 |
| 4 | Novice teachers deal with parents of students. | М | 4 | 12.1 | 12 | 36.4 | 5 | 15.15 | 11 | 33.33 | 1 | 3.03 | 2.79 | 1.14 |
| 5 | Novice teachers have well developed content knowledge. | М | 4 | 12.1 | 11 | | 5 | 15.15 | 9 | 27.27 | 4 | 12.12 | | |

Key: M=mentor, strongly agree=5, Agree=4, Undecided=2, Disagree=2, strongly disagree=1

As indicated from table 4 above, majority of the mentors (51.51%) agreed that novice teachers motivated students in the classroom, while small number (33.3%) of them were disagreed with the idea. For item 2, the larger proportion (60.6%) of the mentors disagreed that novice teachers accommodated difference among adults, but a smaller proportion (27.27%) agreed on the idea. Therefore, novice teachers had a problem in accommodating student difference. For item 3, (51.51%) of them disagreed that novice teachers had problems in evaluating students work properly but, the rest of the respondents agreed on the idea. The result indicates that novice teachers had problems in evaluating students work properly. For item 4,(48.48%) of the mentors were disagreed that novice teachers dealt with parents of the students, while (36.36%) of the mentors agreed on the idea. For item 5, majority (45.45%) of the mentors disagreed that novice teachers had well developed content knowledge but, minority (39.39%) of the respondents agreed on the idea.

The mean score of item1 was above 3(3.18). This indicated that novice teachers motivated students in the classroom. For the remaining four items, the mean score of mentors was below 3(as indicated in table 4). The result indicated that in accommodating students difference, effective evaluation of students, meeting with parent of students, content knowledge, effective technique of questioning, and effective organization of the classroom were the major challenges faced to novice teachers. According to Veenman(1984), novice teachers regarding maintaining classroom discipline, motivating students, accommodating differences among students, evaluating students work and dealing with parents were the most serious challenges they face. Similarly, the researcher found out that through observation and document analysis, novice teachers were faced to the above mentioned problems.

CONCLUSION

The purpose of this study was to gain some insight and understanding of the mentors' roles in guiding and supporting novice teachers of Dangila district primary school. From the results obtained, the following could be concluded.

- 1. Mentors had not appropriate awareness of current teaching trend, understanding of instruction, and also interpersonal skill to establish and sustain positive professional relationships.
- 2. Mentors did not provide well targeted support, had not well planned developmental program to the novice teachers and did not provide progressive feedback properly.
- 3. Mentors and novice teachers of the selected schools had shortage of time and logistic to run mentoring program effectively.
- 4. The major factors that affect mentoring program were time, absence of interest, absence of mentoring training, and few numbers of experienced teachers.
- 5. Novice teachers had problems in accommodating students' difference in the classroom, effective organization of the classroom, and effective technique of evaluation.

RECOMMENDATIONS

On the basis of the findings of the study, the following could be recommended.

- 1. The support obtained from mentors for novice teachers was not effective. Thus, the school principals, supervisors, and officers should provide the necessary assistance for mentoring program implementation.
- 2. It was found out that mentors had not well planned developmental program and also not used their time for novice teachers. Hence, the concerned bodies (i.e. district expertise, school principals, and supervisors) should evaluate the mentoring program.
- 3. It has been pointed out in the study that majority of the respondents revealed shortage of time, shortage of experience teachers, and logistic affecting mentoring program. Hence, the district should allocate budget and employ teachers to reduce work load of novice teachers.
- 4. District education office should encourage teachers that had three years and above to stay in the school for longer years.
- 5. Cluster supervisors, school principals, and mentors should design experience sharing programs to reduce challenges faced to the novice teachers (i.e. how to evaluate students, accommodate student difference, effective organization of the classroom, and invite others to make classroom observation fro best teachers).
- 6. Finally, this study focused on survey of mentors' roles in guiding and supporting novice teachers in Dangila district primary schools. Therefore, interested teachers are recommended to investigate it in- depth and in broader scope of the current situation of the mentoring program with different settings.

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ATTITUDE TOWARDS ENTREPRENEURSHIP AMONG MEDICAL STUDENTS- A COMPARATIVE STUDY

Dr. Swaranjeet Arora and Shakuntala Jain

ABSTRACT

Entrepreneurship and self-employment can be a source of new jobs and economic dynamism in developed countries, and can improve youth livelihoods and economic independence in developing countries. There is general agreement that attitudes towards entrepreneurship, entrepreneurial activity, and its social function are determinant factors for university students to decide an entrepreneurial career. The main objective of the present study is to compare the attitude towards entrepreneurship between male and female students of private and public medical institutes, and their evaluation of the figure of the entrepreneur, contrasting the perceptions of men and women. The study also attempts at narrowing the gap in literature by examining medical student's attitude towards entrepreneurship. The study was based on primary data and respondents were selected from students pursuing medical education. The results shows that there is significant difference in level of entrepreneurial attitude between male and female students. The findings of the present study can counter the findings of previous studies concerning attitude towards entrepreneurship.

Keywords: Entrepreneurship, Attitude towards Entrepreneurship, Medical Students.

INTRODUCTION

According to Allport (1935) attitude is a neural perspective, attained through experience, putting a straight or dynamic influence on the person's response to all the objects and circumstances which it is associated with. Robinson et al. (1991a) articulates that cognitive factors consist of thoughts and beliefs a person has about attitude or object. The effective elements include different feelings towards the object. The behavioral part contains the behavioral intentions and the predispositions to behave in particular way towards the object. Attitudes are defined as the way in which people learn to react to information, circumstances and problems (Harrison, 1997). Attitude consists of all these aspects and could be understood in a better way if all the elements are considered all together (Florin et al., 2007; Breckler, 1983; Allport, 1935). In view of Simpson and Oliver (1990) attitude described as emotional trends in response to persons, affairs, events, locations or even ideas. Attitude is a continuing organization of perceptual, emotional, motivational and cognitive course of action with certain aspect of the environment (Hawkins et al., 1983).

Attitudes play an imperative part in starting entrepreneurial activity in people (Davidsson and Honig, 2003). As individual creates new business enterprise, they have to overcome barriers, solve problems and complete their job (Riege, 2005). They are much disciplined, extremely tenacious, easily commit and recommit quickly and do not get frightened by the challenges (Timmons and Spinelli, 2009).Xavier et al. (2009) denoted to it as the extent to which individuals can perceive that there are many good chances for them to establish an enterprise or the amount of their attitude towards the status of entrepreneurs. Bosma et al. (2008) explained that entrepreneurial attitudes as the level to which people believe that there are some good prospects for starting an enterprise. A nation's entrepreneurial attitude affects the interest of people to become entrepreneurs, their capability to deal with business obstacles and the provision that the entrepreneurs obtain (e.g. from family, relatives and government) while starting a new business enterprise (Bullough, et al., 2014). Though the outcomes of these attitudes are little challenging to evaluate, positive attitude towards entrepreneurship are associate with higher levels of entrepreneurship. Males and females exhibit different views of world due to differences in their experiences and socialization processes (Fischer et al., 1993), which could lead to difference in their attitude with respect to entrepreneurship (Yordanova and Tarrazon, 2010). In view of these differences, the present study is undertaken to understand the difference in the attitude towards entrepreneurship among male and female students of government and private medical institutes.

REVIEW OF LITERATURE

The three main features of entrepreneurs and innovators are their attitudes, skills and knowledge (Garavan and O'Cinneide, 1994). The one of the aspect attitude is the psychosocial forces and cultural context of individual, and has main role in influencing entrepreneurial behaviour patterns (Davidsson, 1995). Veciana et al. (2005) measured and compared the attitude towards entrepreneurship of the university students and the enterprise formation in Puerto and Rico Catalonia, using a sample of 435 and 837 students respectively. The outcome showed a positive image about entrepreneurship and entrepreneur. Still, the perception of practicability was not very positive and only a trivial percentage have strong intention to start a business. Mazzarol et al. (1999) found positive attitude to set up their own business by a group of West Australian entrepreneurs based on the

demographic factors such as gender, age, ethnicity, educational level, previous work experience and family business experience.Nair and Pandy (2006) surveyed the attitudinal and socio-economic features of entrepreneurs in Kerala and noticed that neither inherited business nor religion has any influence on entrepreneurship. Though, age, technical education, economic status of family, training and work experience in related or similar field seems to favor entrepreneurs. It was further stated that entrepreneurs do not differ among themselves on high innovative attitude and internal locus of control orientation. The university students have strong attitude compared to the community college peers on all the four entrepreneurial attitude domains and they are more likely to establish their own business venture than the students from community colleges (Silvestrini, 2016). Males are generally more interested in an entrepreneurial career than females (Blanchflower et al., 2001; Grilo and Irigoyen, 2006), males have higher aspiration and attitude towards entrepreneurship than females (Crant, 1996). The academic research in the field of entrepreneurship is always worth undertaking as entrepreneurship development is always considered as one of the major field of economic and industrial development of every country. Hence, this study is aimed to compare attitude towards entrepreneurship among male and female management students of public and private medical institutes.

RESEARCH METHODOLOGY

Coverage

(i) Universe of the Study

The study will be confined to compare influence of gender and type of institute on entrepreneurial intention among medical students in Indore district of Madhya Pradesh, India. Indore is known as the Educational hub of Madhya Pradesh. As per Medical Council of India 2018 total numbers of private medical institutes in Indore district are three and total number of government medical instituteis one. Total numbers of students studying in private medical institutes are 1250 and total numbers of students studying in public medical institute are 750. The present research is to be conducted on students studying in public or private medical institutes in Indore district, India.

(ii) Sampling

It will be very difficult to cover all the students studying in public or private medical institutes in Indore district, India. Therefore in order to select the sample, multi-stage random sampling technique will be used to select the sample frame.

Stage 1: Selection of Medical Institutes

In stage 1 all government and private medical institutes in Indore district as per Medical Council of India, Madhya Pradesh 2018 were taken for study.

Stage 2: Selection of students

In Stage 2 from the selected group of medical institutes, a total of 300 students were interviewed. The number of students selected for study from government medical institutes were 150 (75 male students and 75 female students) and 150 students were selected for study from private medical institutes (75 male students and 75 female students).

Tools for Data Collection

As this research has a quantitative base so questionnaire used in this research was close ended questionnaire. The research instrument used to collect data was based on Liñán and Chen (2009); Asmara, et al. (2016); and Lűthje and Franke (2003). The questionnaire consists of 12 close-ended questions based on an interval scale. Respondents were asked to indicate their degree of agreement with each of the questions on a five-point Likert scale. The secondary data was collected through various research magazines, journals and newspapers.

Tools for Data Analysis

Kolmogorov- Smirnov Test, One way ANOVA, Post Hoc Tests, Cronbach's alpha and mean has been used to compare attitude towards entrepreneurship of students. The data was analyzed using window based Statistical package of the Social Science (SPSS).

Item Total Correlation

Questionnaire adopted in this study consisted of 12 questions; item total correlation was used in order to check the normality of the sample. As the sample size was 300, item with correlation value less than 0.1948 should be dropped. All the items in the study had correlation values more than 0.1948 thus; no item was dropped from the questionnaire.

Reliability of the Measures

Reliability of the measures was assessed with the use of Cronbach's alpha on all the 12 items. Cronbach's alpha is designed as a measure of internal consistency that is do all the items within the instrument measure the same thing. It allows us to measure the reliability of different variables. It consists of estimates of how much variation in scores of different variables is attributable to chance or random errors (Selltiz et al., 1976). As a general rule, a coefficient greater than or equal to 0.7 is considered acceptable and a good indication of construct reliability (Nunnally, 1978). The Cronbach's alpha for the questionnaire is (0.937) shown in table 1. Hence, it is reliable and can be used for analysis.

OBJECTIVES

- 1. To study and compare the impact of gender differences on attitude towards entrepreneurship among students of government medical institutes.
- 2. To study and compare the impact of gender differences on attitude towards entrepreneurship among students of private medical institutes.
- 3. To study and compare the impact of gender differences on attitude towards entrepreneurship among students of government medical institutes and private medical institutes.
- 4. To open up new vistas of research and develop a base for application of the findings in terms of implications of the study.

HYPOTHESES

 H_{01} : There is no significant difference among male students of government medical institutes, male students of private medical institutes, female students of government medical institutes and female students of private medical institutes with respect to attitude towards entrepreneurship.

 H_{02} : There is no significant difference between male students of government medical institutes, male students of private medical institutes with respect to attitude towards entrepreneurship.

 H_{03} : There is no significant difference between male students of government medical institutes and female students of government medical institutes with respect to attitude towards entrepreneurship.

 H_{04} : There is no significant difference between male students of government medical institutes and female students of private medical institutes with respect to attitude towards entrepreneurship.

 H_{05} : There is no significant difference between male students of private medical institutes and female students of government medical institutes with respect to attitude towards entrepreneurship.

 H_{06} : There is no significant difference between malestudents of private medical institutes and female students of private medical institutes with respect to attitude towards entrepreneurship.

 H_{07} : There is no significant difference between female students of government medicalinstitutes and female students of private medical institutes with respect to attitude towards entrepreneurship.

RESULTS AND DISCUSSION

Kolmogorov- Smirnov Test

Kolmogorov- Smirnov test is performed to test if the values follow normal distribution. This test is essential to decide the statistical test that is to be applied to compare the averages of respondents. The result of the test (table-2) show that values in attitude towards entrepreneurship among students follow normal distribution hence ANOVA can be used for comparing means.

Results of One way ANOVA

Table 3 depicts that the F value for between groups is 14.826 and p value is 0.000 therefore, null hypothesis H_{01} is rejected at 1 percent level of significance. It means that attitude towards entrepreneurship of male and female students in government and private medical institutes significantly differ in their mean values. Male students studying in private medical institutes are having highest mean value of 3.80 followed by male students studying in government medical institutes with mean value of 3.57. While, female students studying in private medical institutes have mean values of 3.27 and female students studying in government medical institutes have mean values of 2.82 which represents that male students have higher attitude towards entrepreneurship than female students and also students of private medical institutes have higher attitude towards entrepreneurship than students of government medical institutes.

In order to find out significant difference between six groups i.e., male students of government medical institutes and male students of private medical institutes; male students of government medical institutes and

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female students of government medical institutes; male students of government medical institutes and female students of private medical institutes; male students of private medical institutes and female students of government medical institutes; male students of private medical institutes and female students of private medical institutes; female students of government medical institutes and female students of private medical institutes Tukey HSD test was applied (Table 4). It represents that p value of male students of government medical institutes and male students of private medical institutes; male students of government medical institutes and female students of government medical institutes; male students of government medical institutes and female students of private medical institutes; male students of private medical institutes and female students of government medical institutes: male students of private medical institutes and female students of private medical institutes; female students of government medical institutes and female students of private medical institutes with respect to attitude towards entrepreneurship is 0.434, 0.000, 0.202, 0.000, 0.003and 0.026 respectively which means null hypothesis H₀₃, H₀₅, H₀₆ and H₀₇ are rejected and H₀₂ and H₀₄ are not rejected. Hence it can be inferred that there is significant difference between male students of government medical institutes and female students of government medical institutes; male students of private medical institutes and female students of government medical institutes; male students of private medical institutes and female students of private medical institutes and female students of government medical institutes andfemale students of private medical institutesstudents and there is no significant difference between male students of government medical institutes and male students of private medical institutes; male students of government medical institutes and female students of private medical institutes with respect to attitude towards entrepreneurship. As expected, men have a higher attitude towards starting a business than women. Such differences are consistent with the results of previous studies carried out in different countries, which have suggested a greater initiative towards self-employment in men compared to women (Crant, 1996; Kourilsky, and Walstad, 1998; Wilson, et al., 2004; Zhao, et al., 2005). Several studies have found that males have a higher attitude for entrepreneurship behavior than females (Delmar and Davidsson, 2000; Kolvereid, 1996). Studies found that males have a significantly higher preference for self-employment than females (Singh et al., 2014).

CONCLUSION

This paper seeks to examine attitude towards entrepreneurship of male and female students studying in government and private medical institutes. The results of present study revealed that there is significant difference between male students of government medical institutes and female students of government medical institutes; male students of private medical institutes and female students of government medical institutes of private medical institutes and female students of government medical institutes; male students of private medical institutes and female students of private medical institutes and female students of private medical institutes; female students of government medical institutes and female students of private medical institutes and there is no difference among difference between male students of government medical institutes and female students of private medical institutes; male students of government medical institutes and female students of private medical institutes with respect to attitude towards entrepreneurship.

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ANNEXURE

Table 1: Cronbach's Alpha (Attitude towards Entrepreneurship among Medical Students)

| Reliability Statistics | | | | | | | | | | |
|-------------------------------|------------|--|--|--|--|--|--|--|--|--|
| Cronbach's Alpha | N of Items | | | | | | | | | |
| .937 | 12 | | | | | | | | | |

Table 2: Kolmogorov-Smirnov Test (Attitude towards Entrepreneurship among Medical Students) One-Sample Kolmogorov-Smirnov Test

| • · · · · · · · · · · · · · · · · · · · | | VAR00001 |
|---|----------------|----------|
| N | | 300 |
| Normal Paramatars ^{a,b} | Mean | 3.3711 |
| Normal Farameters | Std. Deviation | 1.04409 |
| | Absolute | .124 |
| Most Extreme Differences | Positive | .059 |
| | Negative | 124 |
| Kolmogorov-Smirnov Z | | 2.145 |
| Asymp. Sig. (2-tailed) | | .084 |
| a. Test distribution is Normal. | | |
| b. Calculated from data. | | |

Table 3:one way ANOVATest (Attitude towards Entrepreneurship among Medical Students) ANOVA

| VAR00001 | | | | | |
|----------------|----------------|-----|-------------|--------|------|
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 43.009 | 3 | 14.336 | 14.826 | .000 |
| Within Groups | 286.221 | 296 | .967 | | |
| Total | 329.229 | 299 | | | |

Table 4:Post Hoc Tests

| | Multiple Comparisons | | | | | | | | | | | | | |
|-----------|----------------------|-----------------|------------------|------------|------|-------------|---------------|--|--|--|--|--|--|--|
| De | ependent | t Variable:VAR0 | 0001 | | | | | | | | | | | |
| | (I) | | | | | 95% Confide | ence Interval | | | | | | | |
| | VAR0 | | Mean | | | | | | | | | | | |
| | 0002 | (J) VAR00002 | Difference (I-J) | Std. Error | Sig. | Lower Bound | Upper Bound | | | | | | | |
| Tukey HSD | Govt | Pvt male | 24222 | .16058 | .434 | 6571 | .1727 | | | | | | | |
| | male | Govt female | $.77000^{*}$ | .16058 | .000 | .3551 | 1.1849 | | | | | | | |
| | | Pvt female | .31606 | .16058 | .202 | 0988 | .7309 | | | | | | | |
| | Pvt | Govt male | .24222 | .16058 | .434 | 1727 | .6571 | | | | | | | |

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| | male | Govt female | 1.01222^{*} | .16058 | .000 | .5973 | 1.4271 |
|--------|----------|--------------------|---------------|--------|------|---------|--------|
| | | Pvt female | $.55828^{*}$ | .16058 | .003 | .1434 | .9732 |
| | Govt | Govt male | 77000^{*} | .16058 | .000 | -1.1849 | 3551 |
| | female | Pvt male | -1.01222* | .16058 | .000 | -1.4271 | 5973 |
| | | Pvt female | 45394* | .16058 | .026 | 8688 | 0391 |
| | Pvt | Govt male | 31606 | .16058 | .202 | 7309 | .0988 |
| | female | Pvt male | 55828* | .16058 | .003 | 9732 | 1434 |
| | | Govt female | .45394* | .16058 | .026 | .0391 | .8688 |
| *. The | mean dif | fference is signif | | | | | |

APPLICATION OF ORGANIC AMENDMENTS ALONGWITH MULCHING ON ROOT NODULES ENHANCEMENT FOR NITROGEN FIXATIONS ACTIVITY IN GARDEN BEAN

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ABSTRACT

The present investigation on "Effect of mulching and application of organic amendments on root nodules enhancement in garden bean" was taken up in a farmer's field at Sendarapatti village. The experiments were conducted to find out suitable organic practices for augmenting the productivity of tomato by adopting proper crop management practice involving solarisation with various amendments and nutrient management through various organic manures, in addition to proper weed management practices through various mulches. The experiments were laid out in a randomized block design with 8 treatments each replicated thrice. The selected treatment from previous experiment i.e. vermicompost (a) 2.41 t ha⁻¹ (75 % N)+ neem cake (a) 0.22 t ha⁻¹ (25 % N) with Azospirillum and Phosphobacteria each @ 5 kg ha⁻¹ along with panchakavya @ 3 per cent for 4 times for garden bean. Various mulches viz., sugarcane trash, bio-mulch (coriander 15 DAS), coirpith and straw mulch were used after sowing. The treatment schedule included laying such mulches, soil application of fluchloralin (a) 1.5 kg a.i ha⁻¹, fluchloralin (a) 1.5 kg a.i ha⁻¹ + hand weeding once and practice of hand weeding twice along with a control. Among the treatments, application of fluchloralin (Basalin) (a) 1.5 Kg a.i ha⁻¹ along with hand weeding once. Among the various organic mulches tried, the root nodules weight was observed under sugarcane trash mulching (a) 12.5 t ha⁻¹ in garden bean (30 and 45 DAS). This was found to be on par with fluchloralin (Basalin) @ 1.5 Kg a.i ha⁻¹ alone. The root nodules weight and counting were influenced significantly by the weed management practices in garden bean. For the traits, plant height and number of branches at flowering and days taken for flowering, application of fluchloralin followed by hand weeding twice recorded the significant results in tomato. However, hand weeding twice followed by application of fluchloralin with one hand weeding recorded the maximum value for plant height and number of nodules. Both the treatments were influencing the traits at the same level. This was closely followed by sugarcane trash mulching which was found to be on par with fluchloralin (a) 1.5 Kg a.i ha^{-1} alone.

Keywords: Tomato, organic amentments, mulching oil cakes and fluchloralin and root nodule

METHODS

The experiment was laid out in a randomised block design with Eight treatment each replicated thrice as stated in experiment VIII. Capturing the results of Expt VI, nutrient schedule of treatment T_7 -75% of T_3 (Vermicompost @1.18 t ha⁻¹ + Neemcake @ 0.71 t ha⁻¹)+*Azospirillum* + Phosphobacteria (5 kg each ha⁻¹)+Panchakavya @ 3% + Fluchloralin (Basalin) @ 1.5 kg ha⁻¹a.i was followed uniformly for all the treatments. Here mulching was done 20 days after sowing planting and crop culture A significant difference was observed among all the treatment when compared to control. The value for this trait was the highest (294.01 mg plant⁻¹ at harvest) in the treatment T_6 in which application of done. This was followed by the treatments T_8 (291.32 mg plant⁻¹) at harvest there exited weight plant⁻¹ was recorded in the treatment T_1 which served as control

INTRODUCTION

Vegetables provide a good source of income to the growers because they are quick growing and give immediate returns to the growers. They play an important role in human nutrition by providing not only the energy rich food but also promise the supply of vital nutrients like minerals and vitamins. In the recent years, the importance of growing and consuming vegetables for the maintenance of normal health is being realized in all parts of the world and a consciousness for improving quality and quantity has also been developed (Anon, 2014).

The world's vegetable area accounts for 56.69 million hectares and production is around 1087.59 million tonnes. The largest producer of vegetables in the world is China, accounting for 146.55 million tonnes of annual production; followed by India, with a production of around 60.473 million tonnes (Anon, 2016a). As per statistics of National Horticultural Board, the major vegetable producing states in India are West Bengal, Uttar Pradesh, Bihar, Odisha, Karnataka, Gujarat, Andhra Pradesh and Tamil Nadu contributing around 86% of total area of vegetable crop cultivation in the country. The area and production of vegetables in the year 2015-16 was 9.29 million hectares and 16.64 lakh tonnes. The area under Tamil Nadu was 90,533 ha and the production was

8,33,850 lakh tonnes. The major vegetables producing districts in Tamil Nadu are Coimbatore, Ramanathapuram, Tuticorin, Tirunelveli, Virudunagar, Kanyakumari, Madurai, Salem, Tiruchi, Villupuram and Cuddalore (Anon, 2016).

Indiscriminate use of chemical fertilizers, pesticides and herbicides has led to the deterioration of soil health, ground water quality, soil microbial population, atmospheric constituents, quality of the agricultural produce and thereby the health of animals and humans. Soil organic matter is a vital component of the soil that controls the physical, chemical and biological properties to a large extent. Hence now the emphasis is given for the use of organic resources and non-chemical management practices to maintain the soil quality and environmental health in order to produce high quality produce.

RESULTS

Table.. Effect of mulching on Root Nodule number and Root Nodule weight perplant in garden bean

| Treatment | Root Nodule number per plant ⁻¹ | Root Nodule weight (mg plant ⁻¹) |
|--|--|---|
| T_1 – Control | 22.98 | 152.31 |
| T_2 - Sugarcane trash mulch (10 cm thickness @ 12.5 t ha ⁻¹) | 48.08 | 287.53 |
| T_3 - Straw mulch (10 cm thickness @ 12.5 t ha ⁻¹) | 47.17 | 281.12 |
| T_4 - Coirpith mulch (2 cm thickness @ 12.5 t ha ⁻¹) | 27.07 | 275.43 |
| T ₅ - Bio - mulch (coriander was sown 15 DAS maincrop) | 46.69 | 265.12 |
| T ₆ Hand weeding twice @ 30 DAS and 45 DAS | 49.17 | 294.01 |
| T_7 – Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i | 47.73 | 285.21 |
| T_8 - Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i + one hand weeding @ 30 DAT | 48.82 | 291.32 |
| S.ED | 0.06 | 1.52 |
| CD (P=0.05) | 0.12 | 3.04 |

Root nodules weight plant⁻¹

A significant difference was observed among all the treatment when compared to control. The value for this trait was the highest (294.01 mg plant⁻¹ at harvest) in the treatment T_6 in which application of done. This was followed by the treatments T_8 (291.32 mg plant⁻¹) at harvest there exited weight plant⁻¹ was recorded in the treatment T_1 which served as control as shown in the table.97.

DISCUSSION

The Root nodules weight was maximum under the treatments, hand weeding twice followed by herbicide application– fluchloralin (1.5 kg a.i. ha⁻¹) with one hand weeding. Both the treatments were found to be on par with each other. This was closely followed by application of sugarcane trash mulching among the various organic mulches tried. Increase in number of root nodules. Due to application of sugarcane trash mulching weeds due to mulching as reported by Kathiresan *et al.*, (1991). Santappa and Viswanatham (1972) reported that effective soil moisture retention was more pronounced with mulching which had a favourable effect on growth components such as Root nodules weight plant⁻¹production which in turn increased the yield. The superiority of the sugarcane trash mulching over other mulching treatments might be attributed to the higher density over the soil thereby effectively conserving moisture and nutrients, and reducing the weed population ultimately resulted in increased the root nodules yield over straw and coir waste mulching. Similar results of increase in root nodules weight with sugarcane trash mulching is in concordance with the findings of Rajbir Singh *et al.* (2005) in tomato and Manrique *et al.* (2010) in French bean .

CONCLUSION

On the basis of the above results, In garden bean it was 2.41 t/ha vermicompost, 0.22 t/ha neem cake and sugarcane trash mulching 12.5 t/ha for satisfied number and weight of root nodules of cultivated garden bean.

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INFLUENCE OF ORGANIC AMENDMENTS ALONGWITH MULCHING ON YIELD ENHANCEMENT IN GARDEN BEAN

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ABSTRACT

The present investigation on "influence of organic amendments alongwith mulching on yield enhancement in garden bean." was taken up in a farmer's field at Sendarapatti village. The experiments were conducted to find out suitable organic practices for augmenting the productivity of tomato by adopting proper crop management practice involving solarisation with various amendments and nutrient management through various organic manures, in addition to proper weed management practices through various mulches. The experiments were laid out in a randomized block design with 8 treatments each replicated thrice. The selected treatment from previous experiment i.e. vermicompost (a) 2.41 t ha⁻¹ (75 % N)+ neem cake (a) 0.22 t ha⁻¹ (25 % N) with Azospirillum and Phosphobacteria each (a) 5 kg ha⁻¹ along with panchakavya (a) 3 per cent for 4 times for garden bean. Various mulches viz., sugarcane trash, bio-mulch (coriander 15 DAS), coirpith and straw mulch were used after sowing. The treatment schedule included laying such mulches, soil application of fluchloralin (a) 1.5 kg a.i ha⁻¹, fluchloralin (a) 1.5 kg a.i ha⁻¹ + hand weeding once and practice of hand weeding twice along with a control. Among the treatments, application of fluchloralin (Basalin) @ 1.5 Kg a.i ha⁻¹ along with hand weeding once. Among the various organic mulches tried, the yield attributes were observed under sugarcane trash mulching (a) 12.5 t ha⁻¹ in garden bean (30 and 45 DAS). This was found to be on par with fluchloralin (Basalin) (a) 1.5 Kg a.i ha⁻¹ alone. The yield characters were influenced significantly by the weed management practices in garden bean. For the traits, plant height and number of branches at flowering and days taken for flowering, application of fluchloralin followed by hand weeding twice recorded the significant results in tomato. However, hand weeding twice followed by application of fluchloralin with one hand weeding recorded the maximum value for plant height and number of nodules. Both the treatments were influencing the traits at the same level. This was closely followed by sugarcane trash mulching which was found to be on par with fluchloralin (a), 1.5 Kg a.i ha⁻¹ alone.

Keywords: Garden bean, pods, organic amentments, sugarcane trash, bio-mulch as coriander and fluchlorlin

INTRODUCTION

Vegetables provide a good source of income to the growers because they are quick growing and give immediate returns to the growers. They play an important role in human nutrition by providing not only the energy rich food but also promise the supply of vital nutrients like minerals and vitamins. In the recent years, the importance of growing and consuming vegetables for the maintenance of normal health is being realized in all parts of the world and a consciousness for improving quality and quantity has also been developed (Anon, 2014).

The world's vegetable area accounts for 56.69 million hectares and production is around 1087.59 million tonnes. The largest producer of vegetables in the world is China, accounting for 146.55 million tonnes of annual production; followed by India, with a production of around 60.473 million tonnes (Anon, 2016a). As per statistics of National Horticultural Board, the major vegetable producing states in India are West Bengal, Uttar Pradesh, Bihar, Odisha, Karnataka, Gujarat, Andhra Pradesh and Tamil Nadu contributing around 86% of total area of vegetable crop cultivation in the country. The area and production of vegetables in the year 2015-16 was 9.29 million hectares and 16.64 lakh tonnes. The area under Tamil Nadu was 90,533 ha and the production was 8,33,850 lakh tonnes. The major vegetables producing districts in Tamil Nadu are Coimbatore, Ramanathapuram, Tuticorin, Tirunelveli, Virudunagar, Kanyakumari, Madurai, Salem, Tiruchi, Villupuram and Cuddalore (Anon, 2016).

Indiscriminate use of chemical fertilizers, pesticides and herbicides has led to the deterioration of soil health, ground water quality, soil microbial population, atmospheric constituents, quality of the agricultural produce and thereby the health of animals and humans. Soil organic matter is a vital component of the soil that controls the physical, chemical and biological properties to a large extent. Hence now the emphasis is given for the use of organic resources and non-chemical management practices to maintain the soil quality and environmental health in order to produce high quality produce.

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RESULTS

Effect of mulching on yield characters of garden bean

Total number of pods per plant

Significant difference among the treatment existed for the trait total member of pods plant1 (table) the total number of pods plant⁻¹ ranged between 24.72 to 65.99 the maximum value was recorded in the treatment T_6 which served as control. The treatments T_{8} , T_2 and T_7 existed insignificant differences among themselves as presented in the table 1.

Number of seeds per pod

There existed significant differences between the various treatments when compared with control. The value for number of seeds pod^{-1} was the highest (7.14) in T₆ followed by T₈ (6.94) and T₂ (6.80) the treatment T₆ exhibited significant differences with T₈ the last value for number of seeds $pods^{-1}$ was found in (4.80) as shown in the table 1.

Pod length

Thaw variation exhibited by different treatment was significantly higher when compared to control. The treatment mean values of 14.09 cm for pod length was observed to be the highest in the treatment T_6 (hand weeding twice @30 DAT and DAT) this was followed by the treatment T_8 (13.87) the treatment T_2 and T_7 registered insignificant differences among themselves. The least value of 9.12 cm was registered in control (T_1) for pod length (table 2).

| Treatment | Number of pods plant ⁻¹ | Number of seeds pod ⁻¹ |
|---|--|---|
| T_1 – Control | 24.72 | 4.80 |
| T_2 - Sugarcane trash mulch (10 cm thickness @ 12.5 t ha ⁻¹) | 61.89 | 6.80 |
| T_3 - Straw mulch (10 cm thickness @ 12.5 t ha ⁻¹) | 50.49 | 6.42 |
| T ₄ - Coirpith mulch (2 cm thickness @ 12.5 t ha $^{-1}$) | 47.32 | 6.36 |
| T ₅ - Bio - mulch (coriander was sown 15 DAS maincrop) | 55.99 | 6.15 |
| T ₆ Hand weeding twice @ 30 DAS and 45 DAS | 65.99 | 7.14 |
| T_7 – Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i | 61.49 | 6.63 |
| T_8 - Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i + one hand weeding @ 30 DAT 62.0 | | 6.94 |
| S.ED | 0.20 | 0.05 |
| CD (P=0.05) | 0.40 | 0.10 |

Table.1. Effect of mulching on number of pods per plant and number of seeds per pod in garden bean

Table.2. Effect of mulching on pod length and width in garden bean

| Treatment | | Pod width |
|--|-------|--------------|
| | (cm) | (cm) |
| T_1 – Control | 9.12 | 1.68 |
| T_2 - Sugarcane trash mulch (10 cm thickness @ 12.5 t ha ⁻¹) | | 2.82 |
| T_3 - Straw mulch (10 cm thickness @ 12.5 t ha ⁻¹) | | 2.80 |
| T_4 - Coirpith mulch (2 cm thickness @ 12.5 t ha ⁻¹) | | 2.71 |
| T ₅ - Bio - mulch (coriander was sown 15 DAS maincrop) | 13.21 | 2.78 |
| T ₆ Hand weeding twice @ 30 DAS and 45 DAS | 14.09 | 2.84 |
| T_7 – Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i | 13.79 | 2.75 |
| T_8 - Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i + one hand weeding @ 30 DAT | | 2.82 |
| S.ED | 0.11 | 0.010 |
| CD (P=0.05) | 0.22 | 0.020 |

Pod width

The pods width of the plant different significantly against control. The highest pods width of the plant was recorded in T_6 (2.84cm) closely followed by T_8 (2.82cm) the treatment T_1 recorded a value 1.68 cm, which was the lowest when compared to all other treatment as presented in the table.2

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Weight of pods plant⁻¹

Significant positive variation was exhibited by all the treatment for weight of pods plant⁻¹ when compared to control. The highest responses was noticed in the treatment T_6 (hand weeding twice@30 DAT and 60 DAT) which recorded 77.41 percent increased pod weight when compared to control. This was followed by T_8 which was significant in increasing the weight of pods plant⁻¹ to a tune of 74.80 percent when compared to a control. However the treatment T_2 and T_7 were insignificant in exhibiting differences for this trait (table 3)

Effect of mulching on yield per plot and hectare in garden bean

| | Yield per | Yield per |
|---|-----------|----------------|
| Treatment | plot (kg) | hectare tonnes |
| T_1 – Control | 5.74 | 8.23 |
| T_2 - Sugarcane trash mulch (10 cm thickness @ 12.5 t ha ⁻¹) | 18.34 | 12.85 |
| T_3 - Straw mulch (10 cm thickness @ 12.5 t ha ⁻¹) | 16.64 | 12.60 |
| T_4 - Coirpith mulch (2 cm thickness @ 12.5 t ha ⁻¹) | 16.62 | 12.58 |
| T ₅ - Bio - mulch (coriander was sown 15 DAS maincrop) | 16.50 | 11.93 |
| T ₆ Hand weeding twice @ 30 DAS and 45 DAS | 18.82 | 13.96 |
| T_7 – Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i | | 12.83 |
| T ₈ - Fluchloralin (Basalin) @ 1.5 kg ha ⁻¹ a.i + one hand weeding @ 30 DAT | | 13.00 |
| S.ED | 0.03 | 0.06 |
| CD (P=0.05) | 0.06 | 0.12 |

DISCUSSION

The yield attributes such as number of flowers, fruit set percentage, number of fruits, pods and cobs, fruit, pod and cob length, fruit, pod, cob girth, bio mass production and fruit, pods and cobs yield were maximum under the treatments, hand weeding twice followed by herbicide application– fluchloralin (1.5 kg a.i. ha⁻¹) with one hand weeding. Both the treatments were found to be on par with each other. This was closely followed by application of sugarcane trash mulching among the various organic mulches tried. Increase in yield attributes due to application of sugarcane trash mulch might be due to adequate supply of moisture and nutrients which may be altered by controlling weeds due to mulching as reported by Kathiresan *et al.*, (1991). Santappa and Viswanatham (1972) reported that effective soil moisture retention was more pronounced with mulching which had a favourable effect on growth components such as plant height and dry matter production which in turn increased the yield. The superiority of the sugarcane trash mulching over other mulching treatments, and reducing the weed population ultimately resulted in increased the yield over straw and coir waste mulching. Similar results of increase in yield with sugarcane trash mulching is in concordance with the findings of Rajbir Singh *et al.* (2005) in tomato and Manrique *et al.* (2010) in French bean .

CONCLUSION

On the basis of the above results, it could be concluded that the organic practices such as solarization of vermicompost amended soil along with *Azospirillum* treatment in nursery was identified as the best organic way for improving the performance of tomato seedlings. In garden bean it was 2.41 t/ha vermicompost, 0.22 t/ha neem cake, with biofertilizers, panchakavya 3% sprays and sugarcane trash mulching 12.5 t/ha for satisfied yield of garden bean.s

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THREE DECADES OF AIR QUALITY TRENDS IN INDIA: ANALYSING DATA FROM 336 CITIES (1987–2019)

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ABSTRACT

An extensive analysis of PM_{10} , SO_2 , and NO_2 trends in India was undertaken over 34 years (1987–2019) utilizing data from the National Ambient Air Quality Monitoring Programme's manual monitoring sites in 336 cities. The research covered six geographical locations across three time periods, demonstrating a correlation between the rise of monitoring networks and the nation's economic development. The densely populated Indo-Gangetic Plains (IGP) and Central India consistently maintained a higher number of monitoring stations, whereas the Himalayan and Northeast regions experienced significant growth from their original paucity. SO_2 concentrations exhibited a decreasing trend, whilst NO_2 levels remained comparatively steady with occasional swings. In contrast, national average PM_{10} concentrations demonstrated an increase, surging by 128% from 2006 to 2009, attributed to economic activities, building, network development, the 2009 drought, and increased coal usage. Spatially, pollutant concentrations over three blocks indicated enhanced SO_2 levels, with numerous cities above NO_2 norms, and consistently elevated PM_{10} levels in the IGP. PM_{10} concentrations in block 3 were inferior to those in block 2, indicating successful policy measures. State rankings, however, did not uniformly represent pollution trends throughout regions. Regionally, the IGP exhibited the greatest PM_{10} concentrations, whereas the Northeast displayed the lowest levels. Population-weighted exposure values demonstrated a general rise in public exposure to PM_{10} . Examination of principal cities by area in accordance with national patterns, as demonstrated by Delhi (IGP), Guwahati (Northeast), Vadodara (Northwest), and Bhopal (Central), which have exhibited rising PM10 concentrations since 2006, accompanied by sporadic reductions. Conversely, Shimla (Himalavan) and Chennai (Southern) displayed divergent patterns. Prominent industrial cities such Parwanoo, Bongaigaon, Angul, Talcher, and Visakhapatnam reflected national patterns, with PM_{10} levels increasing since 2009, underscoring the substantial influence of industrial operations on air quality. This study highlights the necessity for focused and efficient mitigation techniques informed by spatial and temporal pollution patterns.

Keywords: Air quality, Particulate matter, Historic analysis, Population weighted exposure level (PWEL), Regional air quality.

1. INTRODUCTION

Air pollution is a primary contributor to premature mortality and is classified among the top five hazards on human health and the environment. The situation is worsened in lower-middle and middle-income countries, where populations face both high pollution concentrations and a lack of epidemiological investigations. Air pollution inflicts economic harm estimated at around 1.36% of India's gross domestic product (GDP) [6].

Over the past few decades, various policies and regulatory measures have been periodically implemented to prevent, regulate, and mitigate air pollution in the country, primarily targeting major cities and densely populated regions [5,7,8]. Comprehensive and accurate databases on pollutant concentrations are essential for informed decision-making, enabling policymakers to devise effective ways to mitigate air pollution and protect public health. These datasets are essential for comprehending pollution patterns, pinpointing sources, and evaluating the effectiveness of regulatory actions. In India, three principal sources of air quality datasets are employed: ground-based monitoring, satellite data, and emission inventory-based air quality modelling. Satellite data, albeit offering broad spatial coverage, may be affected by factors such as non-aerosol reflective surfaces and undetectable thin clouds, potentially resulting in mistakes in the obtained results [9]. While emission inventory-based air quality models facilitate the evaluation of action plan efficacy and the direct correlation of sources with concentrations, the intrinsic uncertainties in emission inventories may lead to inaccuracies. Therefore, despite the associated expenses and inconsistent spatial resolution, ground-based monitoring is the most reliable source of air quality data [10]. Consequently, pollution control boards nationwide built monitoring networks that generate primary data on the concentrations of 12 specified parameters (PM2.5, PM10, NO2, SO2, CO, NH3, O3, Pb, Ni, As, BaP, Benzene). Nonetheless, not all of these are observed at every place [11]. Numerous prior investigations in the country utilize these data to evaluate trends [12], confirm air quality models [5], correlate with satellite goods [13], and comprehend the effects of policies [14]. For instance, [15] examined data from 2015 to 2019 and determined that PM2.5 and PM10 concentrations in northern India surpass the national ambient air quality guidelines (NAAQS) by 150% and 100%, respectively. [16] analysed

data from 1996 to 2004 collected from seven stations in the national capital, New Delhi, and noted a transition of days with poor air quality index from winter to summer. [17] employed a decade of data from ten cities in Maharashtra state to conduct a health risk assessment. [18] utilized data from 22 Indian cities to analyse the effect of COVID-19 related lockdowns on air quality.

Many of these studies are limited by their emphasis on particular criteria, narrow geographical areas, or brief timeframes. Furthermore, no studies have evaluated air quality throughout India both geographically and temporally on a national level utilizing primary data. This study seeks to ascertain the geographical and temporal patterns of PM10, SO2, and NO2 over a period exceeding three decades, employing data from manual monitoring stations managed by the National Ambient Air Quality Monitoring Programme (NAMP) in India. This innovative study thoroughly analyses the entire nation, utilizing primary data spanning 34 years (1987 to 2019) from 336 cities, to investigate critical determinants affecting air quality over time and the efficacy of policy measures.

2. MATERIALS AND METHODS

The air quality data included in this study was sourced from manual monitoring stations managed by the National Air Quality Monitoring Programme (NAMP) supervised by CPCB, encompassing metrics PM_{10} , SO_2 , and NO_2 . An extensive dataset of 776,000 daily air quality data points was examined, spanning from January 1, 1987, to December 31, 2019, obtained from 933 monitoring stations located in 336 cities throughout 30 states and 4 Union Territories in India. Only stations with a minimum of 50 days of recorded readings annually were utilized for analysis to guarantee data trustworthiness.

The Standard Operating Procedure (SOP) prescribed by the CPCB, as outlined in the Guidelines for the Measurement of Ambient Air Pollutants Volume I (https://cpcb.nic.in/), was followed in accordance with the notification of the National Ambient Air Quality Standards (NAAQS). PM₁₀ is measured using the gravimetric method, SO₂ is evaluated through the Improved West & Geake Method, and NO₂ is quantified via the Modified Jacob & Hochheiser method. Quality Control (QC) protocols are rigorously upheld through preventative maintenance and calibration of equipment, alongside the examination of field and laboratory blanks. Incoming data is meticulously examined, with abnormal entries—such as three consecutive identical values, zero values, negative values, values below the detection limit, or values exceeding the upper detection limit of the instruments—being removed from the dataset. During this period, a total of 8914 annual data points were analysed, comprising 4828 from residential stations, 2753 from industrial stations, 211 from sensitive stations, and 51 from rural locales, with the station categories unspecified for 1071 data points.

Three principal parameters observed inside the NAMP network—Respiratory Particulate Matter (PM_{10}), Sulphur Dioxide (SO_2), and Nitrogen Dioxide (NO_2)—were chosen for analysis. The monitoring of Suspended Particulate Matter (SPM) commenced prior to the designation of PM_{10} in the second National Ambient Air Quality Standards (NAAQS) in 1994, necessitating the application of a conversion factor of 0.44 to convert SPM to PM_{10} . This factor was determined using the mean ratio of observed yearly average concentrations of SPM and PM_{10} across all six geographical regions. This feature aligns with another prior research conducted in India (Barman, Kumar et al., 2010). As a result, around 2920 PM_{10} data points were obtained through this conversion. A total of 7,258 annual data points for PM_{10} , 8,348 for SO₂, and 8,359 for NO_2 were examined. Annual ambient air quality data for all three metrics was available at 6,447 data points throughout the time run. Since $PM_{2.5}$ data has been accessible only from 2010, following the third modification of NAAQS, it was excluded from the current analysis.

For analytical purposes, the data was segmented into three temporal bins: Block Year I (1987–1993), Block Year II (1994–2008), and Block Year III (2009–2019), corresponding to the second and third revisions of NAAQS. Furthermore, considering India's extensive geographical and climatic diversity, the study categorized the nation into six geographical regions—Himalaya, Indo-Gangetic Plain, Northeast, Northwest, Central, and South—according to general meteorological conditions and locations, as detailed by [14]. The specifics of these geographical locations are delineated in Table 1.

| Classification | States & Union Territories | |
|---|--|--|
| Indo – Gangetic Plain (IGP) | Bihar, Chandigarh, Delhi, Haryana, Jharkhand, Punjab, Uttar Pradesh, West Bengal | |
| South | Andhra Pradesh, Karnataka, Tamil Nādu, Telangana, Kerala, Goa, Puducherry | |
| Central | Madhya Pradesh, Chhattisgarh, Maharashtra, Odisha | |
| Northwest | Gujarat, Rajasthan, DNH & DDU | |
| Northeast | Assam, Meghalaya, Nagaland, Mizoram, Arunachal Pradesh, Sikkim, Tripura, Manipur | |
| Himalaya | Himachal Pradesh, Jammu & Kashmir, Uttarakhand | |
| Table 1 Classification of maximum and data excilability | | |

Table 1. Classification of regions and data availability.

For a comprehensive research, a metropolitan city and an industrial city from each geographic region were chosen based on data accessibility. The selected major cities include Shimla, the capital of Himachal Pradesh in the Himalayas; Delhi, the national capital located in the Indo-Gangetic Plains; Guwahati, the capital of Assam in the Northeast; Vadodara, a prominent city in Gujarat in the northwest; Bhopal, the capital of Madhya Pradesh in central India; and Chennai, the capital of Tamil Nadu in the south. These cities are important urban centres and essential commercial hubs in their respective regions. Delhi, Chennai, Bhopal, and Vadodara are designated as Million Plus cities, whilst Shimla and Guwahati are recognized as Class I cities. The Government of India's Smart Cities Mission encompasses these cities, aiming to promote a sustainable environment by the deployment of intelligent technologies.

This study analyzes six industrial cities: Parwanoo in the Himalayan region, notable for its bulk drug, pesticide, metal finishing, and phosphating industries; Anpara and Singrauli in the Indo-Gangetic Plains, characterized by coal mining and thermal power plants; Bongaigaon in the Northeast, distinguished for its petrochemical complex; Ankaleshwar and Panoli in the northwest, recognized for their chemical, pharmaceutical, dye, and petrochemical sectors; Angul and Talcher in central India, prominent for coal mining, aluminium production, fertilizer units, and thermal power plants; and Visakhapatnam in the south, known for its steel units, petrochemical complex, and chemical industries. Furthermore, these cities accommodate several additional industries, many of which possess significant pollution potential. All cities, except for Bongaigaon, possess industrial clusters or potential impact zones designated by the CPCB in accordance with the Comprehensive Environmental Pollution Index (CEPI). Ankaleshwar and Panoli are designated as Critically Polluted Areas (CEPI score > 70), Parwanoo, Anpara, and Singrauli as Severely Polluted Areas (CEPI score 60-70), and Angul, Talcher, and Visakhapatnam as Other Polluted Areas (CEPI score < 60). Annual rainfall data was obtained from the Rainfall Statistics of India reports published by the India Meteorological Department (https://hydro.imd.gov.in/). The population data was sourced from the Census of India, 2011 (https://censusindia.gov.in/census.website/data/census-tables)

The data was obtained from the Census of India website https://censusindia.gov.in/census.website/data/censustables) and the Gross Domestic Product (GDP) figures were derived from the Economic Survey 2022–23 Statistical Appendix (https://www.indiabudget.gov.in/economicsurvey/doc/Statistical-Appendix-in-English.pdf).

3. **RESULTS & DISCUSSION**

3.1 Economic Growth, monitoring stations and air quality trends across block years

Figure 1 illustrates the allocation of monitoring stations across various block years and areas in India from 1987 to 2019 for the three chosen pollutants. An overall increased trend in the quantity of monitoring stations across all regions is apparent during the three block years, with a particularly significant rise noted in Block Year III. The analysis of the regional expansion of monitoring stations reveals that the Northeast and Himalayan regions, despite their initially lower counts, saw substantial increase of 750% (from 8 to 24 and subsequently to 68) and 400% (from 8 to 16 and then to 40), respectively. The increase can be ascribed to the initially restricted monitoring network in these regions, which has expanded over time, particularly to encompass the swiftly developing commercial and industrial areas in Himachal Pradesh and Uttarakhand (such as Baddi, Nalagarh, Kala Amb, Kashipur, Rudrapur, Haldwani, etc.) within the Himalayan region, as well as 43 rapidly advancing cities in Assam, Meghalaya, Nagaland, Mizoram, Manipur, Arunachal Pradesh, Sikkim, and Tripura, where monitoring stations were originally situated solely in Guwahati, Bongaigaon, and Shillong.

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Figure 1 - Evolution of Monitoring Stations Across the Regions (1987–2019) for (a) Particulate Matter, (b) Sulphur Dioxide and (c) Nitrogen Dioxide.

The densely populated Indo-Gangetic Plains and Central areas continually maintained a much greater number of monitoring stations, reflecting a historical focus on producing extensive air quality data. Both regions experienced significant expansion in the monitoring network, with increases of 218% and 210%, respectively. The South region exhibited a significant 315% rise in monitoring stations, rising from 51 to 90 and subsequently to 212. A notable 59% rise in monitoring infrastructure was observed in the Northwest Region, encompassing highly industrialized towns such as Surat, Vadodara, Ankaleshwar, Vapi, Jamnagar, Ahmedabad, Panoli, Jaipur, Jodhpur, Alwar, and Bhiwadi. The correlation between a substantial increase in Gross Domestic Product (GDP), the proliferation of monitoring stations, and air quality trends throughout the years was examined (Table S1). The augmentation of monitoring stations strongly corresponds with GDP growth across all block years, escalating 1.8 times in Block Year II relative to Block Year I, and 2.2 times in Block Year III compared to Block Year II. During various periods, there has been significant economic growth, with GDP increasing by nearly 4.4 times in Block Year III relative to Block Year I. Consequently, the quantity of monitoring stations rose by a factor of 4.1 throughout the same intervals. This indicates that as financial resources increased and economic activity thrived, environmental issues intensified, leading to a heightened demand for accurate air quality data. As a result, the quantity of monitoring stations rose, particularly in manual monitoring stations, while a significant increase in Continuous Ambient Air Quality Monitoring Stations (CAAQMS) was noted from 2008 onward, culminating in a total of 199 sites during Block Year III.

During the time series of block years, the national annual average concentration of PM10 demonstrates an upward trend correlated with rising economic activities in the country. Although the concentration of SO2 is diminishing, the concentration of NO2 rose in the second block year but fell in the third block year, during which a notable reduction in the national annual average NO₂ concentration was recorded in 2012 and 2013. This reduction coincided with the decline in SO₂ levels during the same timeframe, indicating policy and regulatory intervention targeting a shared source, such as fossil fuel burning, maybe linked to India's clean energy transition plans. Subsequently, NO₂ concentrations rose; however, during the third time block, a total

drop of 12% in NO₂ concentration was observed. Significantly, there is a considerable 95% rise in PM10 concentration from 2009 to 2019 compared to 1994 to 2008, alongside a 24% reduction in SO2 and an 11% reduction in NO2 throughout the same timeframe (Table S1). The significant increase in PM10 concentrations can be ascribed to multiple sources, including heightened industrial and commercial activities, urbanization, and alterations in land use patterns.

3.2 Temporal trends in concentration of PM₁₀, SO₂ and NO₂ over the years

3.2.1. Variation in national annual average PM₁₀ concentration, rainfall pattern and GDP

Figure 2 illustrates the temporal patterns in national average ambient air concentrations for PM10 and GDP at constant prices across the years, accompanied by Figure S1, which depicts the rainfall pattern. Despite the noticeable growth in GDP over the years and variable annual precipitation (Figs. 2 and S1 separately), there is a general upward trend in PM10 concentration nationwide. The concentration of PM10 demonstrates a variable trend from 1987 to 2006, then showing a progressive rise beginning in 2006. Significantly, there are notable peaks, with an initial peak in 2009 (188.5 μ g/m3), followed by declines and a further peak in 2014 (220.3 μ g/m3), becoming the highest national average PM10 concentrations unable to return to pre-2006 levels since that time.





Figure 2. Temporal trend of national average ambient air concentrations for PM10 (μ g/m3) and GDP at constant prices (INR Lakh Crores) across the years. The asterisk denotes the enactment of the second and third national ambient air quality standards in 1994 and 2009, respectively (standard: 60 μ g/m3). The arrow signifies (1) an increase in the construction sector, (2) expansion in industrial activity, and (3) a rise in domestic coal use and drought conditions. The proliferation of surveillance infrastructure and the Global Financial Crisis (GFC) are also noted.

The nationwide annual average PM10 concentration exhibited a progressive drop in the years following the establishment of the second nationwide Ambient Air Quality Standards in 1994 and the third National Ambient Air Quality Standards in 2009.

It is significant to highlight that the national annual average PM10 readings have continuously not met the national ambient air quality requirement of 60 µg/m3 for Residential, Rural, and Other Areas. The interval from 2006 to 2009 is notably noteworthy regarding PM_{10} prevalence, with a 128% rise in concentration. This substantial increase may be attributed to various factors contributing to its persistent elevation. The rise in operable manual monitoring stations from 153 in 2006 to 324 in 2009 signifies a substantial enhancement of monitoring infrastructure throughout this timeframe. The increase in monitoring facilities indicates improved data availability, hence raising the probability of detecting data in previously unreported hotspots. Furthermore, the economic environment in India, especially during the Global Financial Crisis of 2007–2008, significantly influenced PM_{10} levels. Although there was an early upward trend in economic activities, evidenced by a GDP growth rate of around 7.66% from 2006-07 to 2007-08, a subsequent decrease to 3.08% from 2007-08 to 2008-09 due to the crisis necessitated a shift in focus towards encouraging growth. This resulted in increased industrial operations from 2008 onwards, emphasizing production processes at the expense of pollution control measures. The increase in domestic coal usage, marked by a significant 22.8% rise in 2009 relative to 2006, substantially exacerbated PM_{10} emissions (NITI Aayog, 2021). Due to the elevated ash content of domestic coal, it may have become a substantial contributor to PM₁₀. The 2009 drought, marked by a significant rainfall shortfall of 23%, intensified the circumstances. This shortage, coupled with extensive drought conditions, might significantly elevate coarse particulate matter concentration, particularly affecting the Indo-Gangetic plains, central and northwest regions, as well as the Himalayas. Furthermore, an increase in construction activities was prompted by government revisions permitting 100% foreign direct investment in the construction sector in March 2005. The proportion of housing and retail, along with the construction sector, in total foreign direct investment rose from 1.27% in 2001–02 to 4.15% in 2005–06, and subsequently to 11.95% in 2010–11. The augmented investment in construction activities may have led to elevated particulate matter emissions.

3.3 Regional analysis for concentration of PM₁₀ and population weighted exposure levels (PWEL)

Figure 3 illustrates the fluctuations in PM10 concentration and PWEL across three block years, highlighting the alterations in regional air quality over time. Census data was accessible for only one year per block: 1991 for block I, 2001 for block II, and 2011 for block III. Consequently, PWEL values are comparable to PM10 concentrations across different locations, given that the population in each state or Union Territory remained unchanged within the designated block.



Figure 3

During the study period, the Northeast region demonstrates the lowest PM_{10} concentration levels, except for the South region in Block Year II. Conversely, the Indo-Gangetic Plain exhibits the highest PM_{10} concentrations, except for the Himalayan region in block year I. This discrepancy is affected by multiple factors, such as terrain, weather conditions, population density, economic activity intensity, land use patterns, vegetation cover, and transboundary pollution sources. The significant disparity in PM_{10} concentration throughout regions highlights the intricate elements affecting air quality, such as regional variations, weather conditions, and human activities.

4. CONCLUSION

The trends in ambient air quality, based on manual monitoring data collected over three decades (1987–2019), were thoroughly examined for all of India under the National Ambient Air Quality Monitoring Programme (NAMP) for PM₁₀, SO₂, and NO₂. The extension of the monitoring network since 1987 has demonstrated a clear association with increasing economic activities, as indicated by GDP growth. The previously underrepresented Himalayan and Northeast regions saw substantial growth in monitoring infrastructure, although the densely populated Indo-Gangetic Plains and Central regions continually upheld a high density of monitoring stations. Since 2006, the national average annual concentrations of PM₁₀ have escalated due to several factors, including the expansion of the monitoring network, heightened economic growth post the 2007–08 global financial crisis, a construction boom, a drought in 2009, and an increase in domestic coal and lignite consumption. Two significant peaks in PM10 concentrations were observed: 188.5 μ g/m3 in 2009, indicating a 128% increase over 2006, and 220.3 μ g/m3 in 2014. National annual average PM₁₀ concentrations consistently surpassed the

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national ambient air quality limits, in contrast to SO₂ and NO2 concentrations, which generally complied with the established standards. Spatial examination of Indian cities throughout the three block years (1987–1993, 1994–2008, 2009–2019) reflected this tendency, indicating a progressive enhancement in SO_2 levels. Although SO2 levels adhered to national guidelines, NO2 concentrations often surpassed them in many cities. Elevated PM₁₀ levels were especially notable in the Indo-Gangetic Plains throughout all block years. Notwithstanding the mitigating action plans executed in block 3, PM_{10} levels, while still elevated, exhibited a decrease relative to block 2. State rankings for all three pollutants across blocks displayed no uniform pattern. Regional study indicated clear patterns: the Indo-Gangetic Plains consistently had the greatest PM₁₀ concentrations, whereas the Northeast displayed the lowest levels. Population-weighted exposure levels (PWEL) demonstrated a general rise in public exposure to PM_{10} over time. SO₂ concentrations significantly diminished, particularly in the Indo-Gangetic Plains, but NO₂ concentrations exhibited divergent trends across different locations. City-specific analyses confirmed national patterns, with Delhi (Indo-Gangetic Plains), Guwahati (Northeast), Vadodara (Northwest), and Bhopal (Central) exhibiting an increase in PM₁₀ concentrations since 2006, interspersed with sporadic dramatic decreases. In contrast, Shimla (Himalayan) and Chennai (Southern) displayed distinct patterns. The air quality trends in industrial cities (Parwanoo in the Himalayas; Bongaigaon in the Northeast; Angul and Talcher in the Central region; and Visakhapatnam in the South) reflected national patterns, with PM_{10} levels rising since 2009, highlighting the significant impact of industrial activities. This thirty-year trend analysis and spatial distribution of concentrations underscore significant regional disparities, vital for formulating effective and localized mitigation solutions. Consistent efforts encompassing legislative involvement, technical progress, stringent enforcement, and increased public awareness are essential for properly managing PM₁₀ levels across the nation.

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