

Analysis of Labour Productivity of Road Construction in Pakistan

Abu Bakar Muzamil, Bilal Khurshid

Abstract: Construction industry is one of the most labour incentive industries and human resource covers a large project cost. Labour productivity has always been a key issue for project managers to improve their project results. Now productivity studies are getting special emphasize in developing countries after developed countries. Construction industry is basically composed of building and infrastructure projects. Usually productivity studies are focussed towards overall construction industry or mostly building projects. It's obvious that the impact of factors varies with type of construction and other different aspects of project. This study is specifically carried out to identify the critical factors which are responsible for poor labour productivity of road construction in Pakistan. The study was carried out through questionnaire based survey. Questionnaire was composed of 65 productivity factors they were grouped in 13 categories. Respondents were categorized in 2 groups i.e., management workers and manual workers. Respondents were asked to rank the factors based on their experience of road construction. The number of responses achieved were 212 and results were tabulated based on relative importance index. Top three identified critical factors affecting labour productivity of road construction in Pakistan are poor salary, poor execution planning and inefficient equipment. The researchers and project managers can get assistance from the study to establish reforms for achieving better labour productivity.

Keywords- Critical Factor, Productivity

I. INTRODUCTION

Construction industry is one of the oldest and largest fragmented industries of the time. According to Ofori (1990), the construction industry is that sector of economy which plans, designs, constructs, alters, maintains, repairs and eventually demolishes buildings of all kinds, civil engineering works, mechanical and electrical structures and other similar works.

It is quoted that construction industry supports 85 other industries. It includes residential buildings, offices buildings, industrial buildings, water supplies, sewerage and drainage, roads, bridges, airports, irrigation channels, dams, telecommunication and military base camps etc. This industry contributes a lot in socio economic development of some countries (Ng et al., 2009; Wong et al., 2010). Besides this, it's one of the most labour incentive industry for skilled

and even unskilled labour. According to international labour organization report of 2001 there were more than 111 million of construction workers all over the world and most of them were concentrated in low income countries.

According to US Bureau of labour statistics report of Sept. 2013, construction industry added more than 20 thousand jobs in the month of Sept. 2013 in United states.

It added almost £90 billion to the UK economy consisting over 280,000 businesses covering some 2.93 million jobs, which is equivalent to about 10% of total UK employment. In 2007 the construction sector contributed 8.9% in the UK's GVA (Gross Value Added) but in 2011 its contribution reduced to 6.7%. (BIS analysis report, 2013). According to Park (1989), construction sector may have the maximum links with other economic contributors. Many researches (Ball, 1981; Pietroforte and Bon, 1995; Lean, 2001) have confirmed its strong relationship with other industries to elaborate the leading role of construction industry for economy. But linkage with other industries, huge human and monetary resources involvement makes it more complex for management than others. Since in most countries 30 to 50% or may be 60% of project cost may be composed of labour costs (Gomar et al. 2002; Hanna et al, 2002; Jarkas and Bitar, 2012; Guhathakurta and Yates, 1993). According to Ameh & Osegbo (2011), the optimum performance results are not attainable in many countries due to poor productivity results which eventually leads towards time and cost overrun of project. Drucker (1980) argued that reduction in productivities is more dangerous to economy of any country than any other thing as it produce inflation forces, mutual suspicion and social divergence. Therefore labour productivity results get lot of significance by project administration.

Productivity is expressed in many ways but generally expressed as the ratio of output over input or ratio of output to resources which are consumed to produce that output. In construction, the labour productivity is often expressed as a number of labour hours per unit of work, although it may also be expressed as the quantity of work performed by a crew during a standard eight-hour day.

Labour productivity is one of the critical issues in construction industry of developing countries where labour is comparatively cheaper. A report was presented by international labour organization (ILO) on construction output and employment at the end of twentieth century. Data was based on distribution of countries by region and level of their per capita income. The countries with Gross National Product (GDP) per capita above US \$9,266 in 1999 were ranked as high income countries with reference to the criterion adopted in world development report of 2000-01. The tabulated results found are as follows.

Manuscript published on 28 February 2014.

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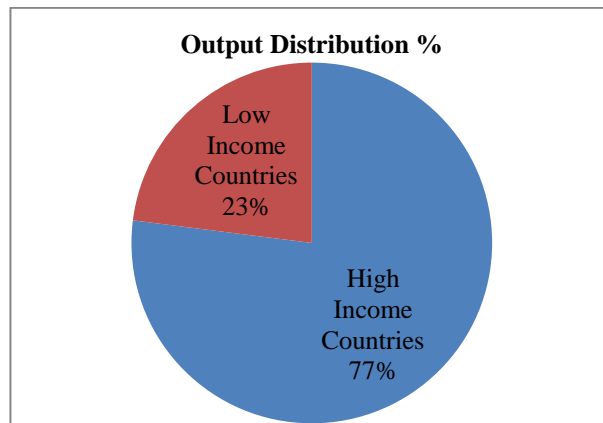
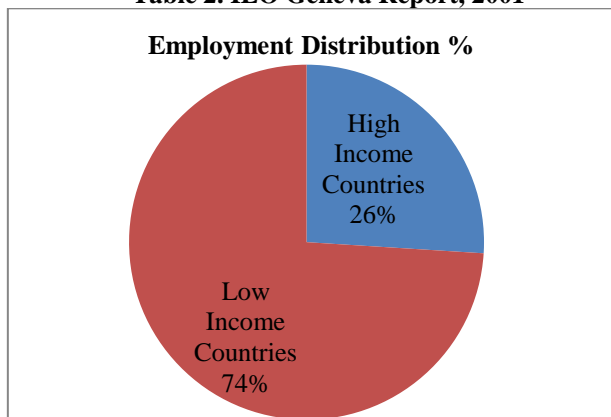
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Table 1. Distribution of Global Employment and Output, 1998 (ILO, Geneva Report, 2001)

Global Distribution Of Construction Employment and Output, 1998							
No. of Countries	Regions	Output \$ in Million			Employment in Thousands (000s)		
		High Income Countries	Low Income Countries	Total	High Income Countries	Low Income Countries	Total
9	Africa	-	20962	-	-	1867	-
23	America	723569	243247	-	9275	10917	-
22	Asia	665556	387831	-	7258	60727	-
2	Oceania	46433	-	-	685	-	-
34	Europe	876546	123345	-	11820	8978	-
90	Total	2312104	701755	3013859	29038	82489	111527
	% of Total	77	23		26	74	

The above results deliberately demonstrate that the productivity or output in construction does not increase by employing more labour. Rather there are other factors that directly or indirectly effect the labour productivity and eventually the construction output. Most of the construction output is contributed by high income countries on the globe. Whereas low income countries despite of employing 74% labour of world only contribute 23% in construction output of world.

Table 2. ILO Geneva Report, 2001



So it has always been a matter of thinking for researchers, engineers and contractors that how this construction output can be enhanced. What are the factors behind, which affect construction labour productivity. Poor productivity is accessed by many researchers as one of the main reasons of time delay, cost overrun and poor quality. (Kazaz and Ulubeyli, 2004). Therefore one can economize the project by properly managing the critical factors that affect labour productivity in the project. Bajaj (2006) and Kazaz (2008) argued that the labour productivity improvement enhance project outcome results. There is lot of research data available regarding labour productivity of high income or developed countries as compared to developing countries. According to Yi and Chan (2013), there are 83 published research papers related CLP (construction labour productivity) by US researchers, 18 by UK and 20 by Canadian researchers. In the result, developed countries have improved their construction output which can be easily judged by the results in above figures. Whereas the developing countries lag behind even by using more human resources. The high income countries of Europe alone had contributed 30% in world's construction output (ILO report 2001). According to Makulsawatudom et al.(2002), even in developed countries still there are factors influencing labour productivity are unidentified and needed to be explored. Although some quantity of research material can be found regarding developing countries but there is much more has to be done. The labour productivity trends of different developed areas are follows.

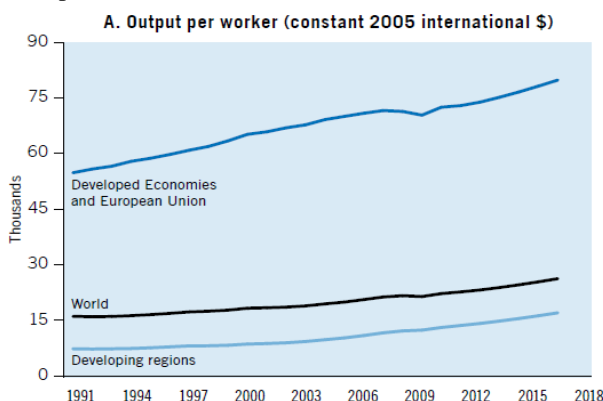


Figure 1. Labour Productivity (Output / Worker), constant 2005 international \$, 1991-2016 (ILO, Trends Econometric Models, Oct 2011)

II.CONSTRUCTION INDUSTRY OF PAKISTAN

Construction Industry of Pakistan has not shown some good results in past because Government of Pakistan has ignored this fertile industry. Now the ministry of industries has officially declared construction sector as a separate industry. Meanwhile the country is going through many economic and power crises along with the war on terror. The Planning Commission has identified abysmally low labour productivity as the most crucial problem for the economy as the country's labour is being least productive in the region with declining performance over the last two decades.(The News, 2011).Construction industry has shown 5.2 percent growth as compared to growth of 3.2 percent in last year (Economic survey report, 2012-2013).

Research material regarding labour productivity of construction industry in Pakistan is quite less. Yi and Chan (2013) conducted a study on research study related to construction labour productivity, by systematic review of well known academic journals in construction management. According to Yi and Chan(2013), there was no published research work regarding construction labour productivity in Pakistan. The critical factors identified in developed or other developing countries may vary with respect to circumstances and conditions of a country (Polat and Arditi, 2005). Accordingly their impact on cost & time of project also varies with respect to diverse environmental, financial, security and other issues of a country(Yi & Chan, 2013). Olomolaiye et al., 1998 elaborated in his research that factors affecting construction productivity cannot be constant for different countries, projects and even within a same project as it depends upon different circumstances and conditions. Likewise road construction is extensively diverse from building construction and other sectors of construction industry.(Ellis and Lee, 2006). Therefore a detailed research study regarding factors, their impact and corresponding improvements for labour productivity of road construction must had been carried out with taking different aspects of the country into consideration.

This research study specifically focused the road projects as road construction is often more laborious and far from population centres. Therefore, labour productivity has always been a significant issue in road projects. After a detailed literature review of construction labour productivity it was observed that there is a huge deficiency of literature specific to labour productivity of road construction. Thomas(2003) mentioned in his research study that he didn't found any research material related quantitative effect of workforce management in highway construction. Similarly Ellis and Lee(2006) stated that he found very few studies related to productivity of road projects.

According to economic survey of Pakistan 2012-2013 country has currently a road network of about 263,415 kms which is utilized by the twenty one million of different vehicles. There are 79 development projects of cost 0.557 billion rupees currently under control of NHA (National Highway Authority) existing of 12,131 kms of length of network including construction of roads, tunnels, interchanges, river bridges, flyovers.

III.FACTORS AFFECTING LABOUR PRODUCTIVITY OF ROAD CONSTRUCTION:

If a loss or an accident happens in performance of a task it is a traditional approach that only the workers directly associated with that task are accused for corresponding loss.

The factors which have somehow contribution for that loss are rarely come into discussion in developing and illiterate areas. In this case, "chain of events theory" broadly helps in conceptualization of loss. It discusses the whole chain of events which have somehow relation in causing that loss and consequently the mitigation to that problem in future. Counteractive steps for the events or factors in the chain can be helpful in loss prevention. Such steps address factors other than simply the action of personnel that are directly connected to event of loss.

Lema et al.(1995) claimed to forecast labour productivity by predicting and understanding factors that influence it. There are lot research studies on identification of critical labour productivity factors but it is different in each country depending upon its geographical, economic and many other conditions.(Olomolaiye et al,1998; Enshassi et al, 2007). Keeping it in view 65 factors were extracted from works of A. Soekiman et al., 2011; Enshassi et al., 2007; Jarkas & Bitar 2011; Kazaz & Ulubeyli, 2006; Attar et al., 2011; Alinaitwe et al., 2007, Hanna et al., 2005;Ellis and Lee, 2006; Lim and Alum, 1995; Durdyev and Mbachu, 2011; Zakeri et al.,1996; Al-Gohary & Aziz, 2014 and interviews with higher officials in road construction of Pakistan.

In this part of research only that factors are focused which may negatively affect labour productivity of road construction in Pakistan. These factors were categorized in 13 groups according to literature and suggestions of senior construction practitioners, namely: External factors, Economic factors, supervision factors, administrative factors, Group interpersonal relationship factors, Individual /worker personal factors, Project design factors, Project execution factors, Material factors, Equipment factors, Health and Safety factors, site layout factors and planning factors.

IV.RESEARCH METHOD

A questionnaire based survey was conducted throughout Pakistan. Questionnaire was composed of 65 factors, which may be responsible for poor labour productivity in Pakistan, from related research on productivity of construction industry. The respondents were divided in 2 categories namely: management group which included top, medium and lower management from client, consultant and contractor firms. Second category was composed of craftsmen, foremen, masons and all type of manual workers. For this case questionnaire was translated in Urdu language to make the labourers understand the questions asked in questionnaire. Systematic random sampling technique was adopted to obtain the best suitable representation of the population. Respondents were asked to rank each factor by a scale ranging from 1 to 5.

Response Scale	Strongly disagree	Disagree	Partially Agree	Agree	Strongly agree
Factor	1	2	3	4	5

To analyze the received data following relative importance index formula (Lim et al,1995) was used:

$$RII = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + n_1}{5(n_1 + n_2 + n_3 + n_4 + n_5)} \times 100$$

where, n₁= No. Of respondents who answered 1

n₂= No. Of respondents who answered 2

n₃= No. Of respondents who answered 3

n₄= No. Of respondents who answered 4

n₅= No. Of respondents who answered 5

The Relative Importance Index (RII) was calculated through above mention equation and factors were ranked with respect to their corresponding RII values.

Almost 250 questionnaires were distributed and internet assistance was also taken to enlarge the number of responses. In response, 164 Completed questionnaires were received back and tabulated along with 48 responses which were received through Google questionnaire survey.

V.RESULTS

Questionnaires were distributed among managerial employees and manual workers who had experience of road construction projects in Pakistan. There were 69 responses received by managerial employees and 143 responses were received by labourers. For the reliability of data cronbach's alpha test was carried out through SPSS software. The cronbach's alpha value received was 0.96 for cumulative responses of both groups. The most influential factors identified by the respondents in the country are poor salary, poor execution plan and inefficient equipment respectively. Top 20 critical factors identified in road construction of Pakistan are tabulated as follows:

Sr. No.	Factors	RII	N	Mean	
				Statistic	Std. Error
1	Poor Salary	0.62	211	3.15	0.1
2	Poor execution plan	0.61	212	3.07	0.09
3	Inefficient equipment	0.6	212	3.01	0.09
4	Improper material storage location	0.59	211	2.99	0.09
5	On time material unavailability	0.59	210	2.99	0.09
6	Indefinite scheduling	0.59	212	2.97	0.09
7	Delay payments to workers	0.59	211	2.97	0.09
8	Poor procedures and policies	0.59	212	2.96	0.09
9	Disruptions in work	0.58	212	2.93	0.09
10	Improper living facilities	0.58	212	2.93	0.08
11	Lack of skill development programs	0.58	212	2.93	0.1
12	Unclear assignment of roles and responsibilities	0.58	211	2.92	0.09

13	Timely equipment unavailability	0.58	211	2.92	0.09
14	Supervisor delay or absenteeism	0.57	211	2.9	0.09
15	Poor discipline	0.57	212	2.89	0.09
16	Health and safety rules violation	0.57	212	2.89	0.09
17	Working without holidays	0.57	212	2.87	0.09
18	Unclear instructions to workers	0.56	212	2.86	0.09
19	Political effect	0.56	212	2.85	0.09
20	Poor Leadership	0.56	212	2.84	0.09

VI.CONCLUSIONS AND DISCUSSION

A. Poor salary

Salary is certainly one of the biggest motivation for a worker who works for an organization for minimum eight hours in a day. It is ranked at 1st place out of 65 factors which are responsible for poor labour productivity in road construction of Pakistan.

Like some other developing countries, labour laws are not properly defined and get implemented in Pakistan. Labour is comparatively cheaper and easily available than high income countries. This factor is also acknowledged by the new government of Pakistan which promised at many occasions to increase the labour pay in the country. Due to poor economic situation of the country, war on terror and energy crisis there is an irregular price hike in food items. In such conditions poor salary should had been certainly the most significant factor for poor labour productivity in road construction.

Likewise delay in payments of workers also create disturbing situation among workforce. Mostly road projects are sponsored by government and it is a certain fact that the payments are delayed in government departments due to lengthy procedures and some other conventional reasons. Poor salary has positive significant correlation with the delay in payment factor which is ranked at 7th place out of all factors. It is justified by Enshassi et al., 2007; Kadir et al., 2005 and Zakeri et al., 1997 by mentioning its 6th, 2nd and 3rd overall position. Both factors result in dissatisfaction of workers which eventually leads towards their poor performance.

B. Poor Execution Plan:

Other than the financial ways the most cheaper and best way to improve performance of any project is by establishing proper management of its activities. On the other hand management generates probably the maximum no. of factors which may affect performance of workers in construction project.



The most basic component of construction management is its planning phase of an activity. In developed countries planning phase got special emphasize to minimize problems in execution phase. It's a famous saying in professional construction experts that more time you invest in planning phase the more time you save in execution phase.

Unfortunately like other regional countries old conventional ways of construction are not yet dominantly swapped by new management skills. In result corresponding crew has to face problems in execution phase which affect project timings and labour productivity. Therefore poor execution planning is ranked at 2nd position by respondents. Execution activities are not precisely defined and planned which lead toward confusion and errors in later stages. In this time of competition, to meet the current quality standards, contractor firms must have to commence execution planning based on modern skills. Activities and factors may change with each project by its topography, environment and stakeholders and they are need to be identified in each plan of a project. Mostly road projects are carried out through government departments therefore it is observed that there is lack of planning in such projects as compared to building construction. There are conventional road construction methods which are somewhat applied as such on every road project. Whereas a construction project is always a unique project with the change of client, site and its conditions. Often there is lack of coordination between departments which also indicates towards planning deficiencies. Construction methods and execution plans are required to be changed with respect to place and requirements of client. For example you cannot implement the same execution plan for Punjab(plain area) and Azad Kashmir (hilly area) of Pakistan. Likewise indefinite and imprecise scheduling is also a factor from this class of management. Time and resources are not efficiently get linked with the logical sequencing of activities which consequently leads towards poor quality, audit inquiries and over budgeting. With discussion with construction experts it is analyzed that often there are disputes due to uneven time and resource allocation to activities which devastate the rhythm of workforce performance . According to Alinaitwe et al., 2007 poor sequencing of work items got overall 5th ranking out of all factors. Along with this there is unclear assignment of roles and responsibilities to workers with corresponding activities. It leads to confusion and misunderstanding among workers whose results are suffered by the project. Indefinite scheduling and unclear assignment of roles and responsibilities to workers are ranked at overall 6th and 12th place. These results by the respondents deliberately demonstrate the poor management practices in road construction projects of the country.

C. Equipment/Tool Factors:

Equipment is a main feature other than efficient management which produced the productivity gap between developed and under developed countries. Equipment is directly related to cost and technology adopted in construction. Road construction has involved some of the gigantic and technological construction equipment. A lot of time can be saved by adopting these modern equipment and tools that certainly result in good productivity results. In developing countries inefficient equipment is one of the critical issue for poor labour productivity. it is ranked at 3rd place with respect to RII whereas timely unavailability of equipment is ranked at 13th place. The result is supported

by the results of Alinaitwe et al., 2007; Zarkeri et al., 1996; Kaming et al., 1997 and Ng et al., 2004 etc.

D. Material factors

Material factors certainly contribute a lot for poor labour productivity of road construction projects as compared to building construction. It is a common observation that labourers waste their time in unproductive work due to improper material storage location or may be due to unavailability of material. Often Improper material storage location is specially a critical issue in repairing or some modification projects like flyover or underpass on urban roads with huge traffic disturbance.

Firstly most of the time road projects are away of population centres to link different areas and secondly road construction material is not so easily available in market comparative to building construction. Mostly material is transported from far of quarries. These material factors reduce the overall productivity of labourers. These factors are ranked at 4th and 5th place with respect to relative importance index. It is justified by many researchers like Zakeri et al., 1996; Kaming et al., 1997; Makulsawatudom et al., 2004; Kadir et al., 2004 and Enshassi et al., 2007 etc.

E. Procedure and Policies:

Procedure and policies are the key components of construction management. They present source of guidance for performance and decision making during any stage of project. The procedure and polices of any organization or project should be precise, simple for adoption and advance, based on modern technology, to compete with modern time for achieving the required objectives and goals. The activities, factors and conditions in road construction projects must be identified and there must be a documented procedure and policy for every situation to avoid deviation from objectives. The conditions of each country varies with respect to various factors therefore construction procedures and policies must be established keeping in view the situation of the country.

Unfortunately there is no appropriate instruction manual for construction in Pakistan. Different manuals of instructions with small alterations are adopted in construction projects. Often when the explanations of these instructions are carried out by different stakeholders of a project it leads towards disputes.

Likewise many public works departments don't have their clear procedures to carry out a unique activity if it is slightly different than their routine tasks. For example often there are deficiencies in policies for maintenance and operation of road projects after their completion. These vague procedures and policies often result in miss coordination of public departments which is ultimately suffered by the project.

F. Disruption/stoppage in work

One of the common critical factors is disruption in flow of work. Disruption in work can be scaled in two types. Firstly the disruption at activity level and secondly disruption at larger scale or project level. It is a common practice at site that the crew is interrupted while working due to small reasons.

The reasons can be design problem, faulty equipment and waiting for material etc. Because of these small interruptions crew is often moved to any new activity. These disruptions are a source of irritation and declination of rhythm of crew. A productivity gap is produced due to movement of crew, installation of equipment to new place and to get pace in new activity. Besides this break in work flow, it is one of the causes of deterioration of previous work and funds are wasted to prepare the previous work. These interruptions in flow of work of crew should be minimized during execution to avoid the these depressions in performance graph. These interruptions then often effect the other activities of projects resulting in minimization of the overall performance of project (Ellis and Lee, 2006), Similarly the disputes during the project produce the same effect on crew performance at larger scale. it is ranked at overall 9th place. This result is justified by Dozzi & Abourizk, (1993) in his research on productivity in construction. Alinaitwe et al.(2007) got it at 7th place out of all factors.

G. Improper living facilities:

Road construction projects are mostly out of population masses and mostly workers get residence at construction site or near construction place. Therefore far from home, living facilities at construction site is also a critical issue for labourers. This factor directly affects the relationship of workers with organization that belong to far flung areas. Like other countries as mentioned by Ailabouni et al. (2007), there are people from specific areas for particular tasks like people from KPK famous for hard manual work, people from Punjab and Karachi as skilled labour. Therefore mostly workers are gathered from far off places. There should be proper residential facilities including recreational facilities, proper sleeping camps, cooking facilities and sanitation facilities etc. This factor is ranked at 10 place. This result is supported by study of Kazaz et al., 2007. Along with good housing facilities, safety and health facilities are also equally important. Due to war on terror and some construction site kidnapping incidents safety got abrupt importance in recent years. Health or medical facility is generally one of the main responsibilities of administration. It is observed that safety and health facilities of lower level workers are of quite poor standard. Health and safety rules violation factor is ranked at 16 place with respect to relative importance index. These two factors are a constant source of dissatisfaction for labour and in case of any accident it may generate an alarming situation for the project.

VI.RECOMMENDATIONS

The study was specially carried out for local construction experts to understand the problems faced by the workers during road construction based on the conditions and circumstances of Pakistan. This study has concluded that the basic needs of labourers must be fulfilled initially to expect good output results from them. Besides this general factor, the most influential factor for road construction practitioners is lack of planning. A massive planning deficiency is usually observed during road construction projects in Pakistan. Contractors and consultants should pay special attention to planning phase to improve profitability and output results of projects. In addition to planning, other key issues specifically relevant to management are material and equipment issues. These two issues are frequently

mentioned by many researchers as critical issues which significantly influence the construction labour productivity. Material quantity should be properly scheduled and equipment should be properly maintained timely. The study can further help construction experts for understanding craftsmen perception towards their productivity. Appropriate policies and procedures should be adopted addressing the critical issues of road construction to produce remarkable figures in construction industry of Pakistan competing with construction industries of other developing countries.

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