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# Human Development and Research-Development-Extension Relationships

Orhan Özçatalbaş

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## Abstract

Human capital is the most important strategic factor for development; as new technologies emerge, the market demand for better and healthier products and consumer demand in terms of quality and delivery time are changing. In today's world, it becomes increasingly important to know how information can be accessed, how it is adopted, and how it can be assimilated. In this respect, each country allocates budget for training, education, and extension according to its own conditions. This budget may be intended for rural community-based social assistance, but the economic and welfare effect is essential. In this way, it is aimed to increase the living standards of the families living in the rural areas. This will naturally contribute to national income and to the prosperity of society. The subject has been discussed generally in the world, especially in the case of Turkey. According to this, all over the world, particularly in developing countries, research and extension (R&E) is very important and should be considered at least as much as research and development (R&D). However, it will be ensured that societies meet with the technology produced. For this, the development of human resources should be emphasized and a suitable atmosphere should be prepared for this widespread prosperity.

**Keywords:** human development, technology, agriculture, research and extension, research and development

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## 1. Introduction

Today, as in yesterday, in the world not all societies benefit from the available resources at the same rate. The population and problems of the world are increasing in the distribution of resources. The population of the world, which was 2.5 billion in 1950, now exceeds 7 billion and in 2050, it is estimated to be 9 billion. In areas, such as education and health,

global solutions are being tried to be produced under the roof of the United Nations (UN). In year 2015, member countries adopted a set of goals to end poverty, protect the planet, and ensure prosperity for all the new sustainable development agenda. According to the UN, new agenda has 17 sustainable development goals for sustainable development which cannot be realized without peace and security. Peace and security will be at risk without sustainable development [1]. There are currently around 750 million people worldwide who are illiterate. Underdevelopment is a tremendous problem, especially among low-developed and developing countries, under the influence of uneducated and old technology. This is more evident in the rural areas and in the agricultural sector.

From the most primitive to the most advanced, every society is in a constant social change. The direction of change is forward, and it is essential to establish a flawless society system. Social change from socioeconomic perspective is to move society from the current situation of production stage to a higher stage. Very rapid social change is causing crises. However, the slow pace of change also reveals some important social and economic problems [2]. As it is known, increasing population and production are the basic dynamics of social change. These dynamics change with the effect. Increasing production is possible only through the technological applications. The new technologies developed in the rural and urban area, the field of application is quite flourishing, the momentum of social change. However, every society changes under the influence of socioeconomic factors. This shows that each society is at certain stages of development due to the characteristics they possess. According to a classification, some societies in the world today bear the characteristics of an agrarian society, some industrial societies, and a small part of the information society. In addition, some societies live the transition period. These societies live under different peculiar conditions, with different forms of production and different production relations. And today we are talking about the revolution in industry 4.0 and the features of this period. These developments affect all sectors whatever the process, there is a great need for urban and rural extension, in addition to formal education, in order to regulate production and consumption relations, especially in the transitional societies.

## 2. Education and extension for development

Studies on education compliance with changing conditions or human resources and factors affecting country's development were started in the eighteenth century with first economist who revealed the idea of classical economics and this process was improved with work by other scientist. According to this, the first attention to the importance of investing in human skills in economic development has been the pioneers of Adam Smith and classical economics. Schultz (1961) and Denison (1962) have shown that education contributes directly to the growth of national income through the development of the capacity and capacity of the workforce. In a study, Denison (1962) found that 23% of the growth in the US production between 1930 and 1960 was due to the increase in the level of education of the workforce. In another study by Denison (1967), 15% of the economic growth was found due to an increase in the level of education. This rate is 12% in the UK, 7% in Italy, and 2% in Germany from other

industrialized countries. Canada ranks first among the countries covered by 25%. The same approach has been applied in some other countries. The results are as follows: 23.2% in Ghana, 16% in Nigeria, 16.5% in Argentina, 6.5% in Honduras, and 3.3% in Brazil. These results in both developed and developing countries, since the 1950s, “a significant part of the growth in output can be explained by the increase in the level of training of the workforce.” However, it should be noted that these estimates are based on various theoretical assumptions. In the following years, many studies were carried out. Again, there is a relationship between education and output growth. In a study by Hicks (1980), in 83 developing countries between 1960 and 1977, the relationship between literacy, life expectancy, and growth as a measure of cooperative development was examined. The findings showed that literacy rates and life expectancy in the 12 countries in which the fastest growth occurred were well above average values [3].

In 1980, in the light of findings revealed the contribution of education to human resources, and economic development was approved. Especially, the importance of education, ensuring the development of human resources in country’s development, has begun to be considered as a concrete. Besides the impact of education on the economic development, significant advantages of compliance of society with new conditions have been proved.

In this context, from 1993 to now, every year studies are carried out by United Nation Development Program (UNDP) on the development of nations and presented in report form. In the report, values of human development index (HDI), health conditions of a country, education level, and human development (HD) calculated from national income allow us to make assessment on the availability of living conditions in the country. For example, according to 2015 human development report, Norway was the best country to live, whereas the Niger was the worst country to live in.

### **3. Human development and research and development (R&D)**

Progress is evident for many measures of human development such as those for health, education, income, security, and participation and for such composite indicators as the human development index (HDI) [4]. According to this, human development (HD) is about expanding the richness of human life rather than simply the richness of the economy in which people live. HD grew out of global discussions on the links between economic growth and development [4]. In terms of showing human well-being, the HD value is an important indicator. Research and development (R&D) is very important for human potential and resource utilization efficiency. Therefore, the R&D capacity of country is important for human development (HD) of that country. The HD index provides insights into the development of countries.

There has been seen significant improvement in the HDI value for world generally and least developed countries particularly. During past 25 years, the HDI value for world increases by more than 20–40% for the least developed countries. There has been gain in HDI by every region of the world. During the past 15 years, although at slower pace, the progress in HDI has been fairly steady across all developing countries, most of the countries have moved up from previous position in human development classification [4].

Up to 2009 human development report, countries were classified in high, medium, and low development groups, whereas from 2010, it was started to classify countries in very high, high, medium, and low development groups. Norway, Australia, New Zealand, and America were ranked at top in 2010 by human development report, whereas Zimbabwe was found at last. In 2010 report in addition to human development index, new three indexes were added, which provide new opportunities to evaluate human development from different aspects. These were expressed as the human development index modified for inequality, gender inequality index, and multidimensional poverty index [5, 6]. Norway, Australia, Switzerland, and Denmark are ranked at top in 2015 by human development report, whereas Niger is found at last. In these conditions, Norway is found to be best country in the world from living point of view. Turkey is holding 72nd position among 188 countries in the list. Despite the effort on demonstration of data aimed at ensuring the assessment on development, index values received by the countries are inadequate to explain the economic size and their place in human development. Hence, in this regard, it is impossible to find exactly something in response to some important questions.

- For example, according to facts given by OECD, Turkey is the 17th big economy of the world. Question is being 17th biggest economy of the world, what position Turkey hold in human development? According to United Nation Development Program's Human Development Assessment, Turkey is at the 72nd position. When considering the difference of 55th ranking between the evaluation result of UNDP and OECD, at first glance it may seem interesting and, there is a need for some interpretation and analysis [7].
- Still having better values of index than Turkey, located in upper ranks in terms of human development countries such as Albania, Bulgaria, Tunisia, and Jordan; again countries such as Qatar and Bahrain found in very high development group with countries found in high development group such as Kuwait, Libya, Saudi Arabia, Iran, Brazil, and Tunisia, when comparing the current political, economic, and social conditions of above-mentioned countries with Turkey's condition, Turkey's position in human development at 72nd can be very difficult to explain. Especially mentioned countries having very low standard of institutes and politics, it is necessary to consider their high natural resources and wealth effect on their presence at top. In this case, at least the effect of natural resources on economic wealth reducing the impact of all other important factors, the issues such as equitable sharing of wealth effects on index also need to be focused.

The following result can be drawn from the example given above:

1. Just moving with economic size does not reflect the development.
2. In terms of human development besides national income indicators such as education standard of living is also important.
3. In revealing the state of development of a country, only economic size (growth) is not enough; with this, importance of indicators like human development and standard of living should be taken into account in analysis.

4. Economic growth does not affect the human development at the same rate.
5. HDI parameter also does not reflect the full rank of human development of a nation.

Essentially for the reasons stated above, there should be debate on national and international levels on the concept of development. In the same contest, the method for calculating IGE, considering the different dimensions of development indicator, up to now is continued to be in the developing process.

R&D is an expensive and long-term process, and it is clear how important it is. There are a variety of indicators which show state of preference or interest a country has shown in R&D. These are shown in **Table 1** and figures as follows:

- Research and development expenditure (**Figure 1**)
- Public expenditure on education (**Figure 2**)
- Education system and functional teaching
- Per capita gross domestic product (**Figure 3**)
- Limitations of the national budget
- Awareness of the subject and culture of innovation
- The presence of qualified researchers
- Well-equipped research infrastructure
- Level of international academic relations
- Sourcing of innovation requests
- Balance between basic research and applied research
- The attitudes and beliefs of the administrators
- Attitudes and beliefs of employees
- Standard of living (**Figure 4**)
- Country and management vision
- Life expectancy (**Figure 5**)
- Human development index (**Figure 6**)

As shown in **Table 1** and **Figure 7**, R&D activities are examined by country groups during the period 2005–2012. According to this, in the high development group, R&D expenditures are highest (2.4% of GDP). Then, the high human development group (1.4%) followed by the medium (1.4%) and low groups (0.5%) are listed. It can be seen that as the level of economic development of the country increases, the share allocated to R&D is also increasing. This suggests that countries in the medium and low groups, especially those in need of redevelopment, should allocate more resources to R&D.

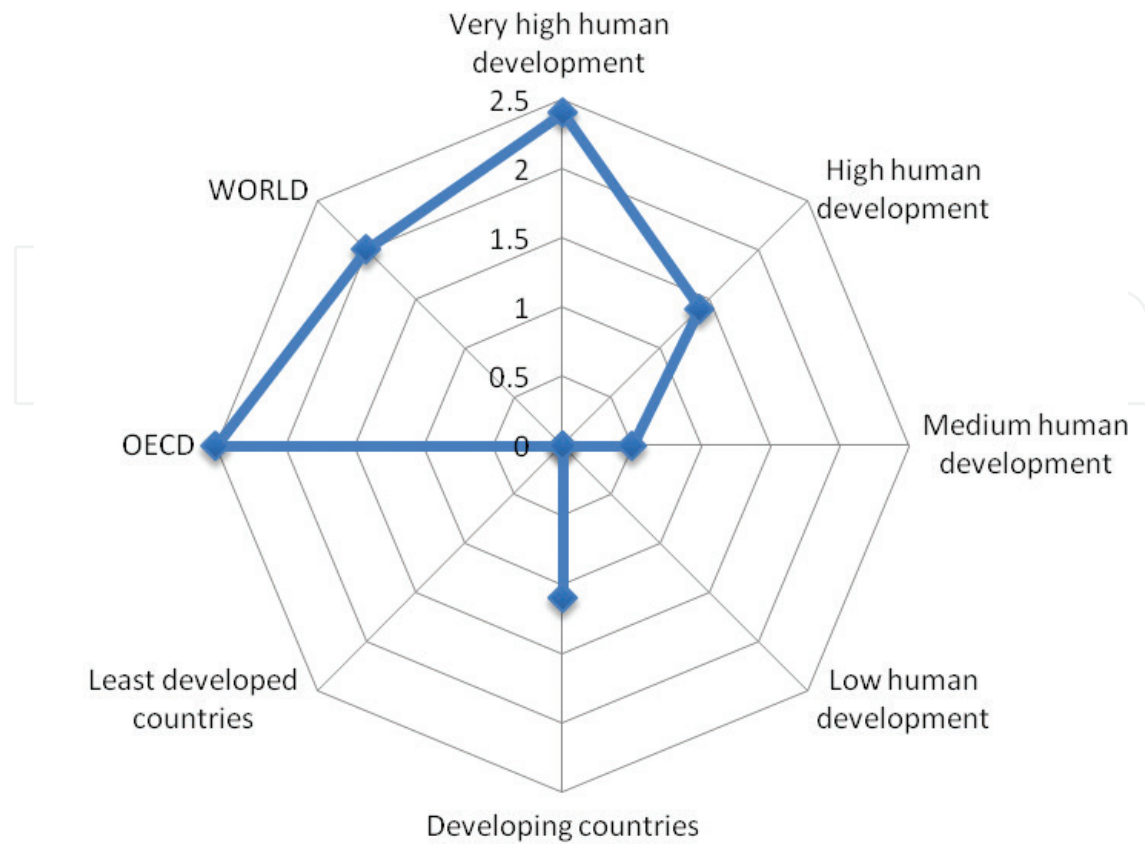


Human development groups	Human development index (HDI) (2014)	Research and dev. expenditure (%of GDP) (2005–2012)	Gross domestic product (GDP) (2011 ppp \$ billion)	Life expectancy (2014)	Per capita (2014 ppp \$ billion)	Public expenditure on education (% of GDP, 2005–2014)	Standard of living (% satisfied 2014)	Employed in agriculture (2012)	Employed in services (2012)	Labor productivity (output per worker) (ppp) (2005–2012)	Export and import (% of EDP) 2013	Internet users (2014) (% of pop.)
Very high human dev. group (49 countries)	0.896	2.4	46,814.6	80.5	41,584	5.1	73	3.3	74.3	64,041	62.5	82.5
High human dev. (55 countries)	0.744	1.4	33,466.1	75.1	13,961	4.9	71	28.8	43.8	23,766	55.6	49.8
Medium human dev. (37 countries )	0.630	0.5	13,654.0	68.6	6353	4.1	63	42.5	35.3	9483	62.3	21.9
Low human dev. (43 countries )	0.505	0	3205.5	60.6	3085	3.6	45	0	0	0	48.4	16.0
Developing countries	0.660	1.1	49,538.3	69.8	9071	4.7	63	36.9	39.1	0	59.3	31.9
Least developed countries	0.502	0	1770.8	63.3	2387	3.4	50	0	0	0	66.8	8.6
OECD*	0.880	2.5	46,521.4	80.2	37,658	5.1	72	5.1	72.3	0	57.0	78.1
World	0.711	2.0	97,521.4	71.5	14,301	5.3	64	30.3	46.0	24,280	60.4	40.5
Norway	0.944	1.7	317.5	81.6	64,992	7.4	95	2.2	77.4	92,694	67.0	96.3
Turkey	0.761	0.9	1398.3	75.3	18,677	5.4	57	23.6	50.4	41,353	57.9	51.0
Niger	0.348	0	15.8	61.4	908	4.2	50	56.9	31.1	0	64.7	2.0

Source: UNDP [4].

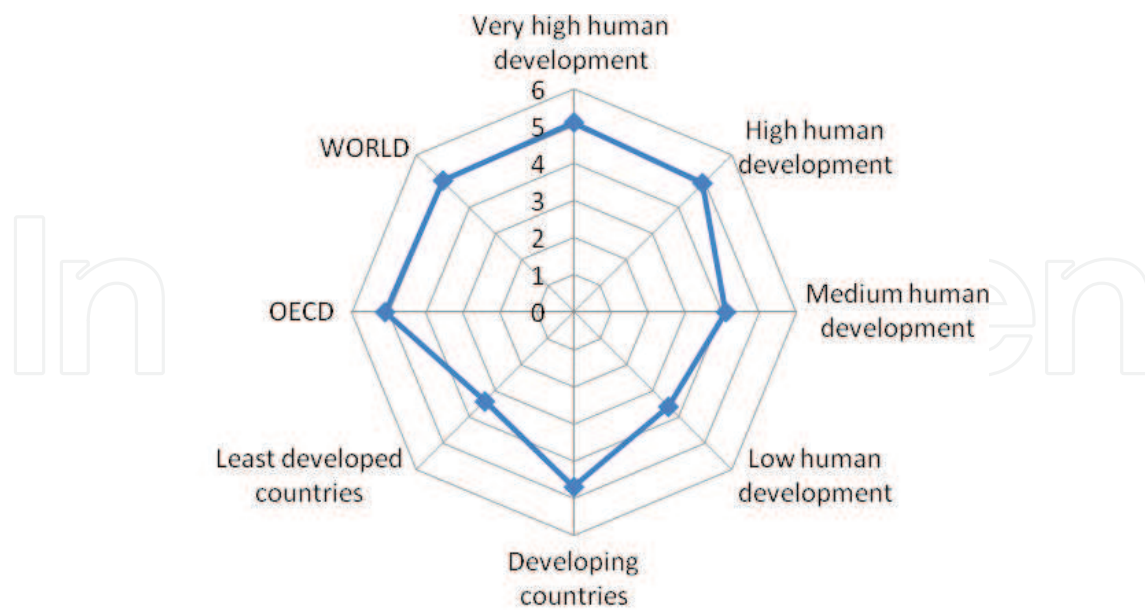
\*Organization for economic cooperation and development.

**Table 1.** Selected some important indicators of human development.



Source : prepared from UNDP, 2015.

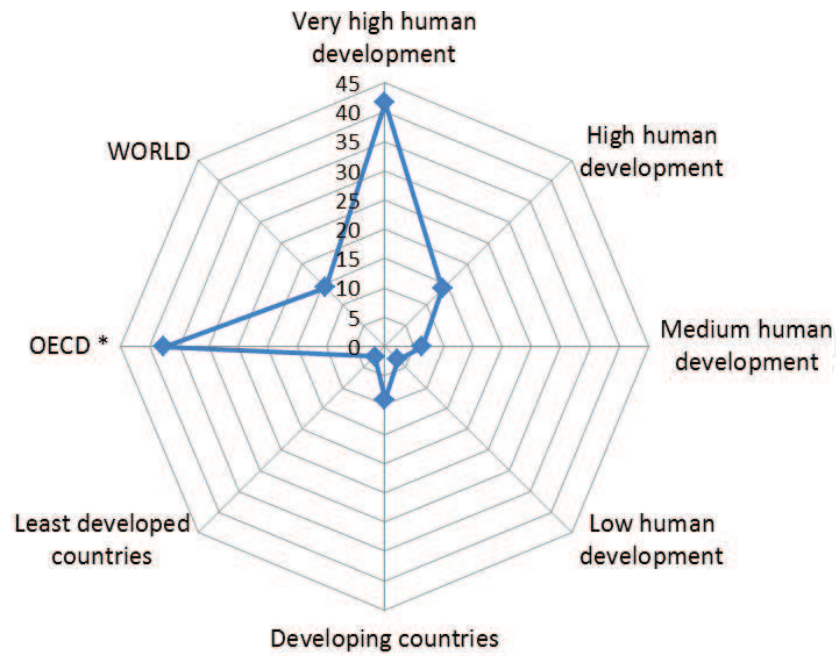
**Figure 1.** Research and development expenditure by country groups.



Source : prepared from UNDP, 2015.

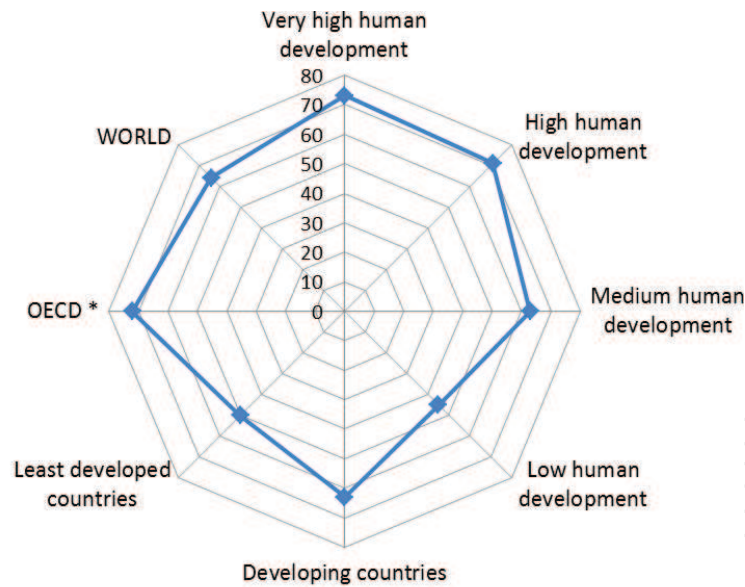
**Figure 2.** Public expenditure on education by country groups (% of GDP, 2005–2014).





Source: prepared from UNDP, 2015.

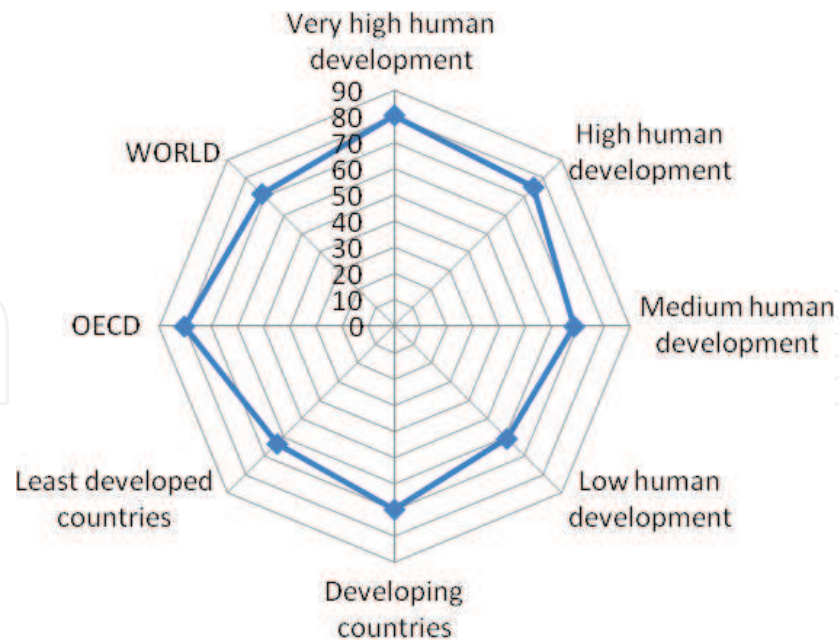
Figure 3. Per capita (GDP) by country groups (2014, PPP\$).



Source: prepared from UNDP, 2015.

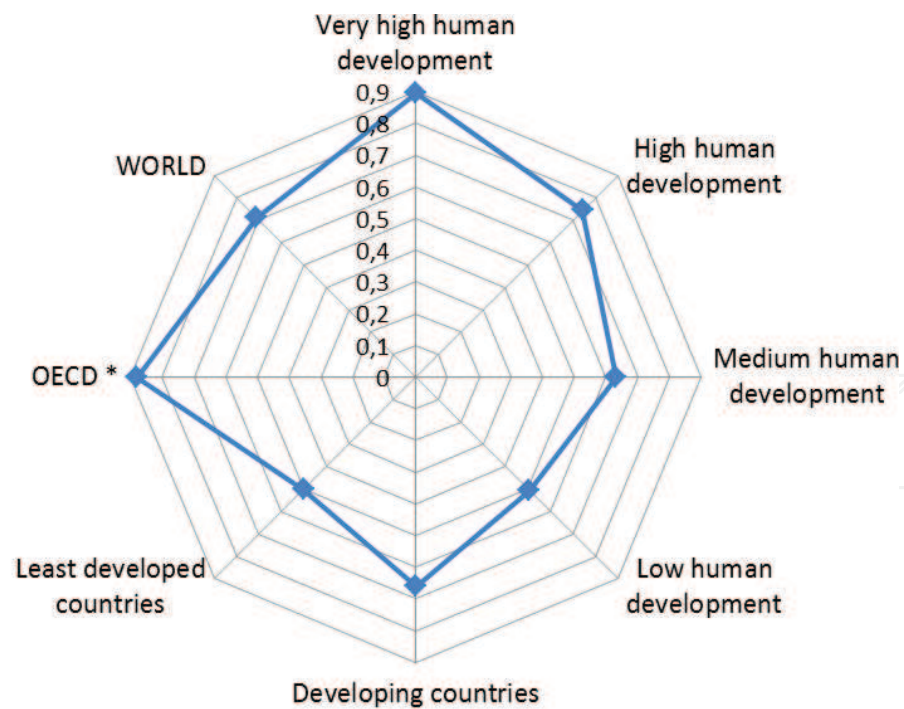
Figure 4. Standard of living by country groups (% satisfied).

The current development is measured by only quantitative data on national income, with national income the average life expectancy of population, education level, and living standard of society will be more meaningful if tried to use in the calculation method to explain development. In this respect, focusing on the development of past 40 years, living conditions in Turkey,



Source : prepared from UNDP, 2015.

**Figure 5.** Life expectancy by country groups (2014).



Source: prepared from UNDP, 2015.

**Figure 6.** Human development index (HDI) by country groups (2014).

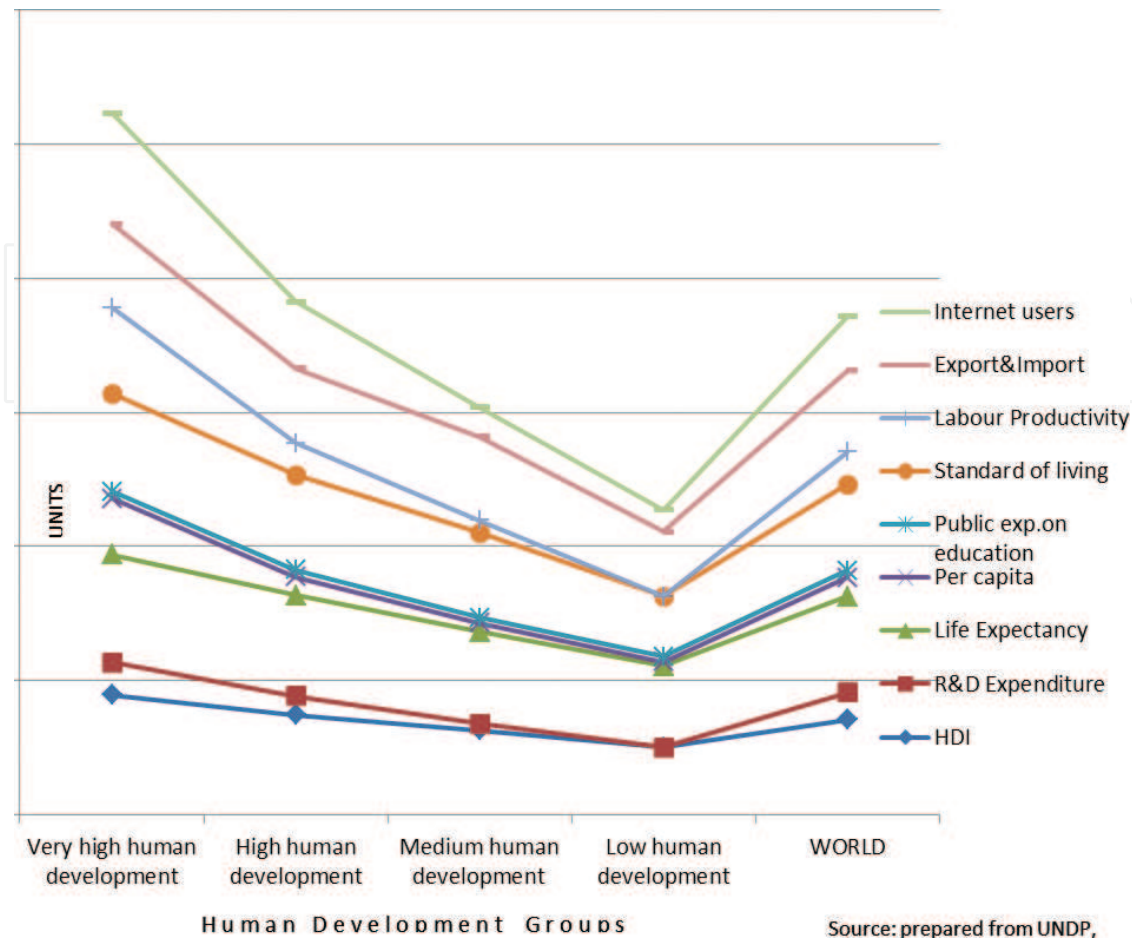


Figure 7. Selected some important indicators by country groups.

Norway, Australia, and Oman are improved by 45, 17, 21, and 1.2%, respectively, and living conditions have been exacerbated in Zimbabwe (27%). As a result, the fact that the some aspects of human development index should be discussed. As a sample, Turkey is in the high development group for human development. Position at the last rows in the group of countries shows that there are many things to be done for the some other countries.

Consequently to increase the prosperity and development of the country, everyone who cares about this has a very big responsibility. For adaptation of this task by community as a mission and in a systematic way, national education policy should be sensitive in this issue and continuity and enforcement is needed. Time is needed for this cause, but from today, anyone who is part of this community in order to contribute to this area should start “doing his job right and doing job by giving his due right.” By developing our sensitivity in this direction, we can sustain this idea by contributing effort in our living and working environment.

#### 4. A research and development (R&D) equipped with extension

The level of societal development is closely related to right planning of human resources and research and development policy. Well-equipped human resource is very important for

research and development (R&D), and R & D has vital importance from resource development and efficient use of resources perspective. Research and development studies are essential for the future of countries. The first goal of the research must be pure science, for the future of humanity. However, the research should be aimed at changing the current situation, improving it, solving problems, and developing new technologies. The delivery of technologies developed in the second stage to the target groups should be the adoption of innovations. Countries get benefits from findings of the science in order to make their development sustainable and move ahead in this race. This is undoubtedly true for every sector. Animal and crop production can be given as an example to see concrete results. Even in terms of measurability of change, animal and crop production branches of science have important advantages. The reason behind countries with high agricultural potential cannot show the expected performance in agriculture is: inadequacies in human resource planning, lack of R&D, and failure to develop technology production capacity, along with ineffective operation of research and extension. Like in every sector, the technology that is produced cannot be delivered to target masses with the right method is big problem and need urgent importance. According to studies, in addition to R&D, R&E should also be considered important. If the findings do not arrive to target groups, sector, and stakeholders, it is not possible to get positive points from the “impact analysis” of the conducted research. For this reason, both research and development (R&D) and extension are important and should go parallel. Sufficient and adequate budget should be allocated to both.

#### **4.1. Research and development policy**

It is very clear that science and technology should be supported with long-term policy. Especially, in ensuring economic and social development, science and technology policies offer significant advantages in determining pace and direction of development.

Agriculture started to witness technological changes when the cultivators first experimented growing wild plants under different growing environment almost 10,000 years ago. For centuries, the technical performance of agriculture more or less remained the same in the great civilizations. Until middle of the nineteenth century, there were not any significant improvements in agricultural productivity. In the nineteenth century, induction of new sources of power and new machinery [8], development of scientific plant breeding led by Mendel's experiment, and development of artificial fertilizers resulted rapid increase in agriculture productivity, principally in Europe and North America.

Research and development often abbreviated to R&D covers all creative work undertaken systematically with a view to increase the sum of knowledge, including knowledge of man, culture, and the company, as well as the use of this sum of knowledge for new applications. In general, the term R&D covers three activities: basic research, applied research, and/or experimental development [9].

In 1960, Turkey switched to the planned development process. With that, the work on formulation of science and technology policies is continuing till date. During this process, Turkish science policy “Turkish Science and Technology Policy Draft (1993–2003)” has been put forward. However, although the documents contain important issues, by not fully putting in practice legal and institutional amendments made it difficult to reach expected results. Later



on, work has been done to formulate a country vision on science and technology commonly accepted by all stakeholders (political institutions, public, private sector, and universities). As a result, “vision 2023: science and technology strategies project” entered implementation phase. Following activities are covered by project, assessing where Turkey stands in the field of science and technology, analysis of scientific and technological developments carried out in world with long-term objectives, acquirement of strategic technologies to achieve said targets, and formulation of policies aimed at developing or acquiring said technologies. According to decision of the supreme council of science and technology, in coordination with other related institutions and establishment, the task of implementation of the project has been assigned to the Scientific and Research Council of Turkey (TUBITAK). Turkey’s R&D policies are based on TUBITAK Vision 2023. Technology fields mentioned in this document (production, biotechnology, food processing, information, protection, diagnosis and treatment, storage and packaging, analysis and measurement, mechanization, and transport) are very closely related to agriculture. Technological activities related to R&D in food and agriculture sector (development of new genotypes seed with combination of classic breeding and technology; production of seed and seedlings; characterization and preservation of genetic resources; variety of processed products and food production methods and processes; food safety and credibility; development of production system in agriculture, forest, food, and fisheries products with help of infrastructure, tools, and equipments; combating disease pandemics with protection, control, and treatment techniques and enabling integrated combating; evaluation and development of natural resources and wildlife; and development and dissemination of remote sensing, early warning system, and information technologies in agriculture and forestry) are related to animal and crops production sector. This draft aims to make Turkey an advance country depending on science and modern technology, by healthy nutrition of society, ability to meet requirement in sufficient quantity and quality, protecting biological diversity and transforming into social welfare, economically, socially, and ecological sustainable, increasing productivity, with help of agriculture and agricultural industry. The Prime Ministry National Science, Technology and Innovation Strategy document [10] makes important description to achieve above-mentioned developments. Attention is drawn toward issues that will increase the functionality of the basic dynamic in the R&D and innovation system; in this way, goal is to achieve sustainability by accelerating the speed of development in R&D and innovation capacity. Again, the development of human resources, encouraging the transformation of research results into commercial products and services, promoting multi-partner and multi-disciplinary R&D and innovation cooperation culture, encouraging SMEs to be stronger actors in the innovation system, increasing the contribution of research infrastructures to Turkey’s research field (TARAL), and enabling international cooperation in the development of the science, technology, and innovation strategy, is stressed in document.

#### **4.2. The importance of extension and research collaboration**

For decades, we know that the possibilities for expansion of cropland declined steadily over the entire planet. Due to deforestation and erosion of slopes, this approach increases the risk of environmental degradation in many parts of the world. That is why the only viable options that remain are increasing yields and the change in product mix. Increasing agricultural productivity is the more urgent task than any other task, the majority of the poor in the developing world

live in rural areas, and the productivity of the sector is actually in decline in many low-income countries. The use of irrigation can dramatically improve yields. The adoption of irrigation requires training of farmers and provides extension services for a long time, but it can lead to a substantial increase in yields without intervention by agricultural research. Yet in most parts of the world, the possibilities of expansion of irrigated areas are also limited and, indeed, many of those already suffering from salinization, water-logging and other issues affecting productivity. Therefore, if it is done unsuitably application to better manage irrigation and extending the yield perimeters, it is impossible to rely on it for the physical basis of agricultural production increases which the world will much need in the future. Meeting this challenge comes mainly heavy agricultural technology development and transfer systems improved, i.e., research and agricultural extension. It also depends on the education systems of farm families; some observers even argue that education is the most important factor in improving productivity.

Fulginiti and Perrin [11] have reviewed the literature on the evolution of agricultural productivity in several countries and made their own estimates using other methodological approaches. They observed that all developed countries have experienced their agricultural productivity increase, whereas most low-income countries have seen their productivity decline, even when they have widely adopted the varieties of wheat and rice from the green revolution. Based on their own analysis, they concluded that the productivity decline is real and that the adverse agricultural pricing policies can be a major cause. The overall picture is however mixed. Masters et al. [12] found improvements in cereal yields in some districts of 13 African countries recently.

Despite some positive points, we can say that the performance of agricultural productivity in developing countries have been encouraging. It is clear that agricultural technology systems of these countries face a major challenge, which is likely to further intensify in the future and which is exacerbated by the general trend of reduced funding for agricultural research observed in developing countries over the past decades.

### **4.3. Research and extension policy**

Research and extension systems play a crucial role in all sectors, especially agricultural and rural development [13]. As is known all over the world, one of the main purposes of extension is to increase the level of living standards of the rural family through nonformal education. Extension has a very crucial role to play in sustainable development [14]. Moreover, they are central to realizing the potential of agricultural innovation. Many developing countries, however, do not have sufficient resources to properly develop their capacity for innovation. More specifically, the activities of agricultural research institutions are often affected by scarce investments and poor financial management, as well as limitations in technology transfer strategies [13]. For that reason, to develop and enhance research and extension relations by suitable policy acts. In this context, it is necessary to make a strong effort to ensure that the findings of the research reach the producer as well as to the adoption. It is absolutely necessary to bring research and extension together.

Modern technologies and innovation are very important for rural development of many developing countries; these technologies are developed by research institutes or universities or in the other case imported from developed countries, which are leading in field of research and



development. Two factors seemed to be very important for farm operators' technology use on farms: a public and private organization engaged in dissemination of recent innovations and technologies to rural areas and second is socioeconomic characteristics and information seeking behaviors of farm operators, which influence their decision to select information sources of information. It is necessary for farm operators to know about how to carry various farming practices like soil preparation, selection of seed and sowing techniques, fertilizations, disease and pest management, irrigation and harvesting, and storage, for the reason of survival in competitive market and more stable income [15]. Agricultural information systems have very important role in rural development. Besides new information create; professional expert and suitable input via several factors is required to develop. Factors those take place in the list are rural folks, field staff of extension organizations, nongovernmental organizations (NGOs), and research institutes, becoming increasingly popular in many countries local municipal authorities [16]. Despite the fact that rural population requires extension services, training, and access to information, share of budget endowed is very limited around the globe [17].

It is necessary to clarify the topic here. In particular, R&D refers to the process leading up to the introduction of a technology. However, even if it is not prevailing in sector like industry where professional sense is dominant, but there are many difficulties in quickly and timely reaching findings of research to target groups, especially in the agriculture sector of developing countries. It is necessary that the technologies that are produced are derived from the old technology and are used rapidly in the production process. From this perspective, research and extension (R&E) is equally important like research and development (R&D). Because there is risk that developed technologies will remain in libraries or electronic data banks without coming in force. From this perspective, budget, time, and human resources are used at great cost to produce these research findings or output, their effectiveness and dissemination is important. For this reason, R&E is important like R&D [18]. There are many ancient examples, especially of not taking advantage of technologies produced in rural areas. Maximum efforts should be made to ensure that research and extension get equal importance.

## 5. Conclusion

Human capital is the most important strategic factor for development and also rural development; as new technologies emerge, the market demand for better and healthier products and consumer demand in terms of quality and delivery time are changing. In today's world, it becomes increasingly important to know how information can be accessed, how it is adopted, and how it can be assimilated. In this respect, each country allocates budget for training, education, and extension according to its own conditions. This budget may be intended for rural community-based social assistance, but the economic and welfare effect is essential. In this way, it is aimed to increase the living standards of the families living in the rural areas. This will naturally contribute to national income and to the prosperity of society.

When Turkey is taken as an example to have huge experiences. in 1846, Agricultural education was started in Turkey. However, the main developments on agricultural research and extension have occurred since the 1930s [19]. Generally, it is developing policies to increase

public prosperity in the new millennium in the framework of these developments. According to this, since the beginning of 2000, Turkey with its policies has made important leaps in the field of human, science, and technology development. Turkey has made significant even radical changes in science and R&D policies. Between 2003 and 2004, while increasing its National Income from 305 to 800 billion dollar and increasing GDP 2.6 times, Turkey increased its R&D expenditures seven times. Therefore, the share of R&D has increased to above 1% of GDP in 2015, which was 0.48% in 2003. Private sector stands first with 49.8% in R&D expenditures, followed by higher education (40.5%) and public institutions (9.7%). In 2014, 51% of R&D expenditures are financed by commercial sector, 26% by public, 18% by higher education, 3% by other domestic resources, and 1% by foreign sources. Agriculture share in R&D expenditure are 4%, out of 572 million dollar 51% is by public sector, 46% by higher education, and 3% by private sector [20]. As a result, in order to reach 2023 targets, Turkey is determined to carry out its consistent and innovative policies in the science and technology field. With increasing R&D share from 1 to 3% and R&E integrity, it will achieve significant improvements in livestock and crop production sector like other in other sectors.

As a result, all over the world, particularly in developing countries, that R&E is very important and should be considered at least as much as R&D. However, it will be ensured that societies meet with the technology produced. For this, the development of human resources should be emphasized and a suitable atmosphere should be prepared for this widespread prosperity.

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