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Evaluation of Adoption of Improved Rice Varieties Among Small-Scale Farmers: A case of Goronyo Local Government Area of Sokoto State, North-Western Nigeria

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Abstract **– This study was undertaken to evaluate the adoption of improved rice varieties among small-scale farmers in Goronyo Local Government Area of Sokoto State, Nigeria. One hundred and twenty (120) rice farmers from three purposively selected rice production communities were randomly selected for the study. Structured questionnaire was the instrument used to gather information from the farmers. Descriptive statistics and linear regression techniques were used to analyze the data obtained. The result of the research revealed that rice farming in the study area is a man dominated enterprise, majority of them were married and in active productive ages. Majority of the farmers were small scale farmers with plots of land of less than 4 hectares. The level of awareness of the farmers on improved rice varieties was very high with mass media as the main source. The improved rice varieties disseminated to the farmers were Ex – China, Faro and Cp varieties and their adoption rate was very poor due to lack of efficient extension delivery system and strong inclination on socio-cultural beliefs. Regression analysis proved a significant relationship between some of the farmers socio-economic characteristics (age, land acquisition and extension contact) while some of the socio-economic characteristics (education and land size) were not significant with adoption of improved rice varieties. The study concluded that there was poor adoption of the improved rice varieties due to poor agricultural extension delivery and strong inclination of the farmers to socio-cultural beliefs, recommending that efficient and trained agricultural extension agents should be deployed to the area to impart knowledge that helps in reducing strong affiliation on socio-cultural beliefs among the farmers.**

Keywords **– Evaluation, Adoption, Small-Scale Farmers, Improved Rice Varieties, Goronyo, Sokoto State, Nigeria.**

I. INTRODUCTION

Rice is a staple food in many countries of the World and Africa in particular and it constitutes a major part of the diet in many African countries. Rice (*Oryza spp*), is an important staple food crop in the continent whose growing demand poses an economic challenge for the African continent (AATF, 2012). Considering its important position, the United Nations designated and adopted year 2004 as the International Year of Rice on December16th, 2002. Devoting a year to a commodity was unprecedented in United Nations history. But however, due to its importance, the 57th session of the United Nations General Assembly noted that rice is the staple food of more than half of the world's population, affirmed the need to heighten the awareness of the role of the crop in alleviating poverty and malnutrition and reaffirmed the need to focus world attention on the role rice can play in providing food security and eradicating poverty and declared the year 2004 as the International Year of Rice (Gnanamanickam, 2009).

Rice *Oryza sativa,* is a cereal food crop that belongs to the grass family called Poaceae of the plant kingdom. Domesticated rice comprises of two species of food crops namely *oryza sativa* and *oryza glaberrima.* These plants are native to tropical and subtropical Southern Asia and South- eastern Africa. The plant can grow in diverse environments, but grows faster and more vigorously in wet and warm conditions. Biologically, the plant develops a main stem and many tillers and may range from 0.6-6.0 metres (floating rice) in height. The tiller bears a ramified panicle that measure between 20-30 cm wide. Each panicle has 50-300 flowers which form the grains (Crawford and Shen, 1998).

It is believed that rice cultivation begun simultaneously in many countries over 6500 years ago. The first crops were observed in China and later as many as 21 of the 39 African countries cultivate rice (Crawford and Shen, 1998). The rice-producing countries in Africa import between 50 and 99 percent of their rice requirements (Oteng and Sant-Anna, 2013). Africa produces an average of 14.6 million tonnes of paddy rice per year (1989-1996) on 7.3 million hectares of land, equivalent to 2.6 and 4.6 percent of the world's total production and rice area, respectively. Africa consumes 11.5 million tonnes of rice per year, 33.6 percent of which is imported. Between 1989-1991 and 1995, the rice import trends showed a small decline of 55 000 tonnes, while paddy production increased by 2.3 million tonnes over the same period (FAO, 1996). West Africa was found to have the greatest rice area in Africa (56.5%), about 3.7 million hectares. The rice area has increased steadily from 1989-1991 to 1996 indicating that between 1989-1991 and 1996 West Africa had the greatest increase in area, whereas the remaining four other regions of Africa showing only insignificant changes (FAO, 2013)

Rice (*Oryza sativa*) is a cereal crop which by far the most economically important food crop in many developing countries, providing two thirds of the calorie intake of more than three billion people in Asia, and one thirds of the calorie intake nearly 1.5 billion people in

Africa and Latin America (FAO, 1996). Rice is the second most important cereal crop in the world after wheat in terms of production (Jones, 1995). Rice crop provides 21% of global human per capita energy and 15% of per capita protein. Although rice protein ranks high in nutritional quality among cereals, protein content is modest. Rice also provides minerals, vitamins, and fiber, although all constituents except carbohydrates are reduced by milling (UNDP, 1997).

Despite the importance and ample fertile land for rice production in Africa, the continent is faced with some inabilities to reach self-sufficiency in rice production as a result of several major constraints in the rice industry which require urgent redress to stem the trend of over-reliance on imports and to satisfy the increasing demand for rice in areas where the potential of local production resources is exploited at very low levels. Some of these factors included non scientific agricultural farming methodologies, lack of adequate farm inputs and good extension delivery system. According to AATF (2012) more than half of the rice consumed in Sub Saharan Africa is imported mainly due to very low yields being experienced by farmers. The average grain yield in Africa was 2.2 tonnes/hectare which is below the world average of 3.4 tonnes/hectare (49%) and several factors account for this low yield. Soil Nitrogen deficiency has been cited as a major constraint to rice production worldwide.

Nigeria as one of the West African countries was ranked as the highest producer and consumer of rice in the continent (Imolehin and Wada, 2000). However, in terms of area of land under cultivation, rice crop production in the country was ranked as the sixth position after sorghum, millet, cassava, and yam (Imolehin and Wada, 2000). Nigeria has a land area of 923,768 square kilometers and over 79 million hectares of cultivable land, out of which only 4.6 million hectares are suitable for rice production. From the 4.6 million hectares only about 1.8 million hectares or 39% is currently utilized for rice production. The estimated annual rice demand by Nigerians was estimated at 5 million metric tonnes, but only an average of 2.21 million metric tonnes were produced as of the year 2007 leaving a deficit of 2.279 million tones which is normally bridged by importation from Asian countries (National Bureau of Statistic Report, 2007). Efforts aimed at expanding rice crop production is required and subsequent issues of improved technologies particularly high yielding and diseases resistant varieties are considered suitable for the various agro-ecological zones suitable for the production of the crop in the country.

During the past three decades the crop has seen consistent increases in demand and its growing importance is evident in the strategic food security planning policies of many countries. With the exception of a few countries that have attained self-sufficiency in rice production, rice demand exceeds production and large quantities of rice are imported to meet demand at a huge cost in hard currency. In an attempt to boost rice production in the country, Federal government has designed policies and programmes aimed at boosting domestic rice production through establishment of large scale dams and Fadama development programmes purposely to meet the domestic demand for the crop since 1989 (Idiongs, 2005). The establishment of the large scale dams was done with aim of impounding rain water through water-sheds to a particular point and later release to farmers through surface and sprinkler irrigation most especially during the rainy season, while the Fadama programme was established to boost rice and other crop production through the provision of tube wells and water pumps to the participating farmers.

Goronyo Local Government Area happened to be one of the rice producing areas in Sokoto state due to presence of ample Fadama land and the Goronyo large scale dam. Both rain fed and irrigated rice farming are being practiced by the farmers and even landless farmers served as labourers through which life is maintained in the area. Rice was found to be one of the most important cereal crop cultivated in the area, as such there is need to mobilize and encourage the farmers towards accepting and practicing science - based oriented agriculture and rice farming in particular through introduction of improved rice varieties and other agricultural inputs. These if accepted and adopted by the farmers helped by acquiring more yield, reducing drudgery and improvement of their livelihood.

Adoption of an innovation by a farmer is considered as a mental process which he goes through in deciding whether to adopt or reject the provided innovation (Rogers, 1962), as a result there is need for mounting a serious public campaign by the extension agents as well as the Government policies such as Agricultural Development Project (ADPs); Green Revolution (GR); Fadama Rice Production programme and Rima River Basin Development Authority (R.R.B..DA) among others, in collaboration with the efforts of research institute and Universities in advocating the benefit of using improved rice varieties such as: Cp 25, Cp 27, Cp 33, Ex-china 25, Faro 27, and Faro 33. Despite the abundance of improve rice varieties, the farmers of the study area still insisting on the adoption of the traditional local varieties of rice which are low yielding and susceptible to drought, pest and disease. Such commonly used local varieties by the farmers are *yarkukuma* (dwarf rice variety) and *bahausa* (native rice variety).

In view of the above, it is considered important to evaluate the adoption of improved rice varieties in the study area with the aim of finding out the reasons behind not adopting the introduced rice varieties in the study area.

1.1 Objectives of the study

The general objective of the study is to evaluate the adoption of improved rice varieties in the study. The specific objectives are to:

1. Describe the socio-economic characteristics of the farmers.
2. Ascertain the farmers' awareness of improved rice varieties in the study area.
3. Examine the factors influencing adoption of improved rice varieties by the farmers.
4. Determine the adoption of improved rice varieties among small-scale farmers in the study area.

II METHODOLOGY

2.1 The study area

The study on the evaluation of adoption of improved rice varieties was conducted in Goronyo Local Government Area of Sokoto State, Nigeria. The Local Government Area lies between latitude 130. 27′N and longitude 5^0. 40′E. The area falls within the Sudan savannah agro-ecological zone of the country. The minimum Temperature of the area is 20-23^{o}C and the maximum day's temperature for most of the year is 43^0C with an average of temperatures of 33^{o}C. The raining season started from May/June and lasted between September/October with a minimum rainfall of 500mm and maximum of 800mm. The area experienced two trade winds, namely the N-E trade wind which blows from the Sahara desert, brings in cold and dusty wind popularly known as Harmattan wind and the S-W trade wind that blows from the ocean, which brings in rainfall in to the area (Wikipedia Goronyo, 2013). The Local Government Area has land mass of 1,704km^2 with a population of 182, 296 people (NPC, 2006). Most of the people in the study area are Hausa/ Fulani by tribe and farming and fishing is their main occupation. The common crops cultivated are millet, rice, sorghum, maize corn, and vegetables. Livestock such as cattle, camels, goat a sheep are also reared.

2.2 Sampling procedure and Sample size

The whole Local Government Area (Goronyo) constitutes the sampling frame of the study. The area has 21 villages that participated in rice farming. Three out of the 21 villages in the Local Government area were purposively selected for the study because of the abundance rice farming activities taking place. The villages selected were Keta, Falaliya, and Gidan yarfara. Simple random sampling technique was employed to select 40 rice farmers from each of the selected villages, making the sample size of the study to constitute 120 rice farmers.

2.3 Source of Data and Analysis

Both primary and secondary data were used in collecting information for the study. The primary data was collected through the administration of structured questionnaire while the secondary data was restricted to textbooks, journals, and internet sources. Descriptive statistics such as (frequency distribution, percentage) and inferential statistics (regression analysis) were used to analyze the data obtained.

2.4 Measurement of variables

The respondents personal characteristics such as age was measured in years; Marital status was measured based on married, single and divorce; respondents sex was measured as male or female; Educational attainments was measured based on Primary school attended, Secondary school attended, tertiary school and Non-formal education attended; Land acquisition was measured based on gift, hired, inherited, and purchased; size of land cultivated by the respondents in hectares; farming system adopted was based on rain fed, and irrigated farming; and extension contact based on weekly contact, monthly contact, and once in a year. The type of improved rice varieties aware of was based on Ex-China, Faro, Cp etc ; and the source of information on improved rice varieties was measured based on extension workers, neighbours, mass media etc. The use of agricultural inputs was measured based on the inputs applied by the farmers such as fertilizer, and herbicides. Awareness of the improved rice varieties was measured based on yes or no. Acceptance and trial of the improved varieties was measured based on yes or no while the season for the trial was based on rainy and dry seasons. The reasons for not adopting the technology were based on low yield, familiarity with the local varieties and susceptibility of the technology to drought, weeds, pest etc.

III. RESULT AND DISCUSSIONS

3.1 Farmers' socio-economic characteristics

3.1.1 Sex

The findings in Table 1 shows that majority (92.5%) of the farmers were males, while only (7.5%) were females. The findings implies that most of the rice farmers were males and this could be attributed to the fact that rice farming is a tedious agricultural activity and as such only males were found to partake in it while the female are left with processing of the produce. This statement is in accordance with the findings of Ango *et al* (2012) that rural female farmers are not statistically identified as an active population in farm operations. As a result, their productive economic roles are regarded as part of their domestic and reproductive roles.

3.1.2 Age

As shown in Table 1, majority (61.6%)of the rice farmers were within the age range of 43years and above and 21.7% were within the age bracket of 31-42 years while 16.7% were within the age group of 18-30years. The findings implies that majority of the rice farmer were within the active productive ages to cope with the rigours of rice farming. This finding is in corroboration with Ango *et al* (2011) that the active productive ages of an individual are the period in which the person is more capable and energetic to carry out agricultural activities.

3.1.3 Marital status

As indicated in Table 1, 78.3% of the rice farmers were married while only few (21.7%) were single and none was a widow or widower. This indicates that s were majority of the farmers were married because marriage was considered as a sign of responsibility most especially among the people of the study area.

3.1.4 Educational level

Majority of the respondents (80%) had non-formal education, 16.7% had primary education, 3.3% had secondary education and none was found having attended higher institutional schools **(Table 1).** The implication is that most of the respondents had one form of education or the other. Though at low level, education is expected to enhance adoption of farming techniques. This finding is accordance with Williams (1978) that farmers' educational level has direct relationship with adoption of improved agricultural technology.

Table 1: Distribution of rice farmers Socio-economic Characteristics **(a)** (n=120)

Variables	Frequency	Percentage
Sex		
Male	111	92.5
Female	9	7.5
Age		
18-30years	20	16.7
31-42years	26	21.7
43years and above	74	61.6
Marital Status		
Married	94	78.3
Single	26	21.7
Widow/widower	0	0.0
Educational Attainment		
Primary school	20	16.7
Secondary school	4	3.3
Tertiary institution	0	0.0
Non formal education	96	80.0

Source: field survey, 2009

3.1.5 Farmers´ land acquisition methods

The findings in Table 2 reveals that most (55.8%) of the farmers acquired their plots of farmland through inheritance, 20.8% of the farmers hired the farmland, 16.7% of the farmers purchased the farmlands while few (6.7%) of the farmers obtained their farmland through gift. The findings indicated that most of the farmers obtained their plots of farmland through inheritance. This finding is in line with Ango *et al* (2011) most of the lands in the rural areas on which the villagers farm are being inherited from their parents most especially, the male child.

3.1.6 Size of farmlands

As shown in Table 2, 35% of the farmers had 1.1-2hectares of farmland, 32.5%had farmland of 2.1-3hectares of farmland and 26.7% managed 0.5-1hectare while only 5.8% of the farmers managed large farmlands. The findings of the study therefore reveal that majority of the farmers in the study area managed small plots of farmland, which could be due to lack of capital among the farmers to managed large farms. This result is based on the findings of Bello *et al* (1998) who reported that majority of the farmers of Sokoto Rima River Basin operate on a small - scale basis with only 2-3 hectares of Fadama plots under their operation.

3.1.7 Farming system practiced

Farming in the Fadama land by the people in the study area was mostly practiced in both the rainy season and in the dry season. The dry season farming is mostly practiced with help of either the large scale dams or with the use of tube wells. The result in Table 2 reveals that 46.7% of the farmers practiced dry season farming through the use of tube wells and water pumping engines and 35.8% of the farmers practiced rainy season farming while 17.5% of the farmers were found practicing both dry and rainy seasons farming in the study area. The result indicates that all the farmers were found engaging in farming business year round which could be due to abundance of Fadama land and the Goronyo large scale irrigation dam in the area.

3.1.8 Farmers' extension contact

Most (50.8%) of the farmers had extension contact only once in a year, 30% had no extension contact at all, 10% of the farmers were visited by extension workers on monthly basis and few (9.2%) of the farmers had contact with extension workers on weekly basis **(Table 2)**. The findings imply that there were weak and or no extension coverage by the extension workers in the study area, which might have negative implication on the acceptance and adoption of improved agricultural technology which repercussions leads low agricultural productivity by the farmers. This agricultural procurement and extension agencies needs to work together in order to meet the needs and aspirations of farmers in the study area in order to promote food security. This enhances the development of confidence in the agriculture extension agents by the farmers (Uzonna and Qijie, 2013).

Table 2: Distribution of farmers socio-economic characteristics **(b)** (n=120)

Variable	Frequency	Percentage
Farmers land acquisition		
Gift	08	6.7
Hired	25	20.8
Inherited	67	55.8
Purchased	20	16.7
Size of farmland		
0.5hectare-1 hectare	32	26.7
1.1 hectares -2 hectares	42	35.0
2.1 hectares -3 hectares	39	32.5
3.1 hectares and above	7	5.8
Farming system practiced		
Rain fed farming	43	35.8
Irrigated farming	56	46.7
Both rainy and dry season farming	21	17.5
Farmer extension contact		
Weekly contact	11	9.2
Monthly contact	12	10.0
Once in a year	61	50.8
No ext. contact	36	30.0

Source: field survey, 2009

3.2 Farmers' source of information on improved rice technology

3.2.1 Awareness of improved rice varieties

Table 3 shows that most (55.8%) of the rice farmers were aware of the availability of improved rice varieties in their localities while 44.2% of the farmers were not aware of the presence of improved rice varieties in their localities. This indicates that information on the presence of improved rice technology was disseminated to the farmers.

3.2.2 Farmers' source of information

Table 3 indicates that the main source of agricultural information among the farmers of the study area was through mass media (37.5%), 28.3% of the farmers source of agricultural information was from the extension workers and 26.7% of the farmers source of information was obtained from the neighbours while few (7.5) of the farmers source of information was from the middlemen.

3.2.3 Rice varieties aware of

Majority of the farmers (66.7%) were aware of the Ex-China variety in their locality, 13.3% of the farmers were aware Faro 27 and 6.7% of the farmers were aware of Cp 25 while only 3.3% of the farmer were aware Cp 27 **(Table 3)**. The findings imply that all the farmers were aware of the presence of improved rice technology in the study area which could be due to the presence of many radio and television agricultural programmes aired by different radio and television stations in the State in addition to the efforts of the extension workers.

Table 3: Distribution of farmers based on awareness, source of information and the type improved rice varieties aware of (n=120)

Variables	Frequency	Percentage
Awareness of improved rice varieties	67	55.8
Yes	53	44.2
No		
Farmers source of information	34	28.3
Extension workers	45	37.5
Mass media	32	26.7
Neighbours	9	7.5
Middlemen		
Rice varieties aware of and adopted	80	66.7
Ex-China	16	13.3
Faro 27	8	6.7
Cp25	6	5.0
Cp33	6	5.0
Faro33	4	3.3
Cp 27		

Source: field survey, 2009

3.3 Agricultural inputs applied

3.3.1 Fertilizer Application

The findings in Table 4 revealed that majority (83.3%) of the farmers applied inorganic fertilizer (farm yard manure), 10% applied organic fertilizer (NPK, Urea and SSP) while 6.7% of the farmers applied both organic and inorganic fertilizers. This indicates that all the farmers in the study area applied different types of fertilizer to their crop plants purposely to increase yield of the crop.

3.3.2 Weed control measures

Most (58.3%) of the farmers applied mechanical weed control measures while 41.7% of the farmers applied chemical herbicide **(Table 4).** The finding implies that farmers in the study area are culturally biased and as a result they do combine adoption of any agricultural technology with the cultural means purposely to avoid total failure of crop. This express similar view by Williams (1978) that Nigerian farmers were surrounded by many deep rooted socio-cultural factors which hinder the farmers from accepting change, it also justify Osuji, (1983) statement that social psychological factors such as personal beliefs played a vital role in adoption behavior.

Table 4: Distribution of farmers based on application of different weed control measures (n=120)

Variables	Frequency	Percentage
Fertilizer		
Organic fertilizer	100	83.3
Inorganic fertilizer	8	6.7
Both organic & inorganic fertilizer	12	10
Weeds control measures		
Mechanical weed control	43	35.8
Chemical herbicides	77	64.2

Source: field survey, 2009

3.4 Adoption and reasons for not adopting

The finding in Table 5 shows that most (60.8) of the farmers did not adopt the introduced rice varieties while 39.2% of the farmers adopted the varieties and the reasons for not adopting the improved rice varieties include Familiarity with the local varieties (67.5%), Susceptible to drought and pest attack (26.7%) and low yield (5.8%). Majority (75. 8%) of the farmers that accepted the introduced rice technology adopted the varieties during the dry season of the year while few (24.2%) adopted the varieties during the rainy season. As could be seen from the findings, the reasons for not adopting the technology by the farmers were not based on poor yield but socio-cultural and psychological orientation. This finding is in line with Williams (1978) and Osuji, (1983) that Nigerian farmers were surrounded by many deep rooted socio-cultural and psychological factors which hinder the farmers from accepting and adopting agricultural change.

Table 5: Distribution of farmer based on adoption, season of adoption and reasons for not adopting improved rice varieties (n=120)

Variables	Frequency	Percentage
Adoption of improved rice varieties	47	39.2
Yes	73	60.8
No		
Season for adopting improved rice varieties	29	24.2
Rainy season	91	75.8
Dry season		
Reasons for not adopting improved rice varieties	7	5.8
Low yield	81	67.5
Familiarity with the local varieties	32	26.7
Susceptible to drought and pest attack		

Source: field survey, 2009

3.5 Hypothesis

There is no significant relationship between the farmers' socio-economic characteristics and adoption of improved rice varieties.

The result of the estimated regression as shown in Table 5 revealed that, the co-efficient of determination (R^2) for the regression model was 0.46 implying that about 46% of variation of the adoption was explained by the

independent variables included in the model. The remaining proportion can therefore be attributed to random error estimation.

The result obtained through linear regression analysis further revealed that age (X_1) of the farmers was significant at 1% level while land acquisition (X_5), land size (X_6) and frequency of extension visit (X_7) were significant at 5% level while others were found not significant. These findings imply that some of the farmers' personal characteristics with positive coefficient such as age (2.079), land acquisition (2.184), and extension contacts (301) have direct relationship with adoption of agricultural technology. This finding is in agreement with Osuji (1983) that socio-cultural factors such as age, education, and the distance separating the farmers from the extension worker affect adoption of agricultural technology.

While those independent variables with negative regression coefficient such as marital status (-0.311), education (-0.146), and that of farm size (-1991) indicates that there was no significant relationship between such farmers personal characteristics and adoption. The result implies that being married or not, small or large farm size and the farmers educational status does not increase or decrease the farmers' rate of adopting agricultural technology.

Table 5: Test of research hypothesis (personal characteristics and adoption of improved rice varieties)

Variable	Regression Coefficient	Standard Error	t- ratio	R^2	Adjusted R	F-value
Constant	1.636	.730	2.240**			
Age	2.079	.008	2.571***			
Education	-0.146	.024	-1.342***			
Land acquisition	8.595	.039	2.184**	0.469	374	4.909***
Land size	-.156	.078	-1.991**			
Extension contact	301	.153	1.972**			

*** Significant at .01%, ** significant at 05%, * significant at 10%

IV. Conclusion

Based on the findings of the research, it is concluded that rice farming in the study area was a male dominated business, majority of the farmers were married and were in their active productive ages. Majority of the farmers operated on small plots of lands of less than 4 hectares and the lands operated on were mostly acquired through inheritance. It was also realized that there was efficient means of disseminating agricultural information to the farmers, of which mass media was the mostly patronize by the farmers. The findings of the study proved that farmers of the study area were aware of improved agricultural technology and the common rice varieties disseminated in the area were Ex-China, Faro and Cp improved varieties of rice. Adoption of improved rice varieties among the farmers was found to be very discouraging due to strict socio-cultural inclination which could be due to weak and inefficient extension education and delivery system. It's finally concluded that some of the farmers' socio-economic characteristics influence adoption of agricultural technology while others did not.

Recommendations

In accordance with findings of the research the following recommendations are suggested:

1. Efficient agricultural extension education deemed necessary in the study area to reduce strong cultural inclinations that hinders acceptance of change.
2. More efficient and trained extension workers are suggested in order to provide reliable agricultural information and training to the farmers.
3. Agricultural technologies that are compatible with the farmers' local initiatives are suggested.

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1. Analysis of Socio-economic factors of Brown sugar Production in Gwandu Local Govt. Area Kebbi State, Nigerian. Nigerian Agricultural Development Studies Vol. 2(1). 2000
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