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Exploring the outflow of population from poor areas and its main influencing factors

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ABSTRACT

Population outflow, one of the essential causes of rural decline, increasingly weakens and hollows rural main bodies, which is particularly detrimental for poor areas. Although a plethora of scholars have focused on the characteristics and driving mechanisms of this form of migration in macro-scale research, few studies have closely addressed the outflow process and determinants of the floating populations from rural impoverished areas. This study investigated Fuping County, which is one of the national designated poverty-stricken counties in China, as a typical study case. Using first-hand data, obtained from questionnaire surveys, together with an ordinal logistic regression model, the results showed that in poor areas, outflow working helps to increase the income of job-seekers 1.37 times; however, in turn, this causes demographic-structural imbalances of the rural population. Household ties and basic living conditions can restrain a certain number of rural labors from migrating into urban regions, even though a spatial mismatch exists between high-income demands and high-income opportunities. The quantity of the floating population shows a typical U-shaped trend with the expansion of the flow range, and, because of the "agglomeration shadow" effect, urban regions within the province (17.67%) are less attractive than metropolises outside the province (19.67%). The promotion of a rural revitalization strategy urgently needs to retain the outflowing populations and stimulate the vitality of rural areas; thus, this study calls for a more targeted policy design, considering the employment preference and actual demands of the rural to urban floating population.

1. Introduction

Because of the accelerated processes of urbanization and industrialization, China currently witnesses a surge of population migration, which has become one of the largest migrations in the world (Bai, Shi, & Liu, 2014; Gu & Ma, 2013; Li, Wang, Han, & Yu, 2011). There were more than 2.8 hundred million peasant workers in China in 2018, the majority of which have no formal qualifications required for city residency, such as stable employment, high education background, and adequate years of social security contributions payment. Thus, they have to maintain their double residential (home villages and cities) status (Luo, Zhang, Wu, Shen, Shen, & Xing, 2018; Zhu, 2007) and are referred to as "floating population".

Population is one of the most essential components of rural regional system (Cheng, Liu, & Zhou, 2019; Yang, Liu, Li, & Li, 2018;). Under ideal circumstances, the floating population could flow smoothly and randomly between urban and rural regions, which not only maintains the spatial dynamic balance of the population, but also promotes socio-economic operation. However, in reality, the spatial redistribution of the floating population is characterized by significant urban-orientation, and it is more common for rural populations to move toward urban destinations, compared with moving the other direction. The existence of this one-way depopulation in China is closely attributed to the *Hukou* registration system, which ties public services (e.g., jobs in healthcare, education, pension, or the public sector) to the formally registered place of residence of the population (Tang & Feng, 2015; Whalley & Zhang, 2007). Urban residents (with nonagricultural *Hukou*) in a location (e.g., a municipality) are favored in public resources allocation compared with rural residents (Afridi, Li, & Ren, 2015). Consequently, rural job-seekers respond to these relative inequalities by voting with their feet. Even during periods of economic recession, they never stop moving to cities in search of urban economic opportunities as

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well as to escape rural poverty (Mohabir, Jiang, & Ma, 2017; Xing & Zhang, 2017).

Such large-scale spatial replacement of population aggravates the urban-rural discrepancies in both physical and socio-economic conditions (Long, Liu, & Li, 2010). Although the Chinese government has made great attempts to strictly limit the size of already large cities, while encouraging the growth of small cities and towns, as well as by supporting the establishment of rural enterprises, little direct empirical evidence exists on the impact these efforts have on farmers' propensity to outflow. Examination of recent research showed that a plethora of scholars highlighted the influx impacts of the floating population toward urban destinations. An important strand of research focuses on urban settlement intention and social exclusion (Akay, Bargain, & Zimmermann, 2012; Chen & Liu, 2016; Liu, Deng, & Song, 2018,). Few studies have closely focused on the outflux process of the floating population and the resulting and often profound social ramifications on rural origin areas, particularly with regard to impoverished regions that face the long-term dilemma of population net loss.

Impoverished regions have been at the bottom end of economic growth in China, and are often characterized by the absence of the rural main body, the hollowing and degradation of rural land, as well as the backwardness of industrial development (Zhou et al., 2018). Rural scholars used to focus on the land issues in poverty-stricken areas, and have proposed valid countermeasures targeted at poverty alleviation like land use policy innovation (; Liu, Fang, & Li, 2014,(Liu, Li, &Yang, 2018) , (Liu, 2018)), and rural land consolidation (Li, Liu, & Long, 2014; Liu & Wang, 2019; Zhou, Guo, & Liu, 2019). Evidence based on recent research also indicates that during the current urban-rural transformational stage, the continuous outflow of rural populations has high significance on rural pauperization. On the one hand, the loss of rural population in impoverished regions widens the urban-rural divide and accelerates rural decline (Liu & Li, 2017). On the other hand, rural pauperization decreases the vitality of rural regional systems and forms an enormous "push" for the outflux of rural populations (Zheng & Liu, 2018). This forms a vicious cycle of poverty, which urgently requires more specific empirical studies to identify the driving mechanisms of this population outflow from poor areas. Section 2 reviews the available literature on the motivations of this migration, and identifies the deficiency of existing research.

1.1. Literature review

Migration and population redistribution have always been major concerns for both policy makers and social scientists (Zai & White, 1993). Early explanations of population migration tried to identify the underlying rules mainly by using deductive induction methods. Several classic theories, based on certain assumptions, have formed the basis of modern research on population floating and migration. For instance, neo-classical economic theories proposed that rural-to-urban migration is driven by the withdrawal of surplus rural labor force from traditional agriculture, and the wage differences between urban industrial sectors and rural agricultural sectors (Lewis, 1954; Ranis & Fei, 1961). Bogue (1969) and Lee (1966) proposed the "Push and Pull" theory, which indicated that migration occurs under a combination of pulling forces, pushing forces, and the links between them. Todaro (1976) emphasized the importance of individual decisions, proposed the "Todaro Migration Model" theory, and argued that rural job-seekers migrate to maximize their "expected gains", which are based on the disparities between real income and the probability to obtain jobs. Stark (1991) further investigated the social characteristics of rural-urban migrants, and proposed the theory of "relative deprivation", which attributes the migration decisions of rural laborers to their economic position relative to a reference group.

Since the late 1990s, with the improvement of the urbanization level, in developing countries, a large body of rural surplus labor has been released from the land, which led to a more irregular and varied exchange of the urban-rural population. Moreover, relevant research on floating population and its driving mechanisms has gradually shifted from theoretical deduction to empirical quantitative analyses, and has more concentrated on multi-dimensional perspectives. For instance, several researchers considered the role of economic backgrounds and governmental policies in the spatial redistribution of moving laborers. Such factors include the taxation, the household registration system, and the rural land system (Spilimbergo, 1999; Mullan, Grosjean, & Kontoleon, 2011; (Bosker, Brakman, Garretsen, & Schramm, 2012)Bosker at al., 2012). Social origins and corresponding social welfare, to some extent, also increased the attractiveness gap between urban and rural labor markets (Knight & Gunatilaka, 2010; Zhang & Treiman, 2013). Other researchers focused on the household behaviors and social networks of rural migrants (Liu, Li, & Breitung, 2012). Empirical evidence showed that being too old and having to care for family members, are two of the main perceived reasons that keep migrants from outflowing (Knight, Deng, & Li, 2011).

The results of recent determinant research showed that a variety of driving forces are greatly significant in the process of population floating, including demographic factors, social and cultural factors, economic factors, housing factors, and environmental factors. Tian (2013) showed that as the frequency of migration increases, more migrants move into low-income cities, although flows toward high-income cities still form the majority. Chen et al. (2018) and Su, Tesfazion, and Zhao (2018) reported that family units have become the most common carrier of the floating population, and further explored the roles of culture, institutional barriers, and dialect for explaining inter-provincial migration. However, not all of these forces are applicable for the analysis of the motivation of rural-to-urban population floating, and few studies have considered the spatial dimension on a micro scale (e.g., county). With regard to spatial factors, existing studies generally regarded the features of population outflow in the same administrative unit as being consistent in nature, which failed to integrate the differences between individuals.

This paper regarded each poor individual as relatively independent, and compensated for the above deficiency by using first-hand GPS location data of respondents. The improvement of the study in comparison to regular spatial analysis is the breaking of administrative division boundaries, and the provision of a more micro and accurate perspective of the influencing factors analysis in population migration issues. Based on the field investigation data for Fuping County, in 2016, this study explored the outflow range characteristics and influencing factors of the floating population of impoverished regions. Specific indicators for rural poor areas are considered, such as housing and drinking water safety, and the availability of basic public services. Additionally, with the help of precise GPS locations, spatial influencing factors at the micro-scale were considered. The findings contribute to the literature on the mechanisms of rural-urban floating population, and empirically identified more targeted policy suggestions for rural poverty alleviation and rural revitalization.

2. Materials and methods

2.1. Study area

Fuping County (N38°09′–39°07′, E113°45′–114°31′) is situated in the southwest of Baoding City, Hebei Province, China. The county has jurisdiction over 13 townships and 209 administrative villages, and covers an area of 2496 km^2 (Fig. 1). Since 1987, Fuping County has been designated as a national impoverished county, and has become one of the 32 counties in the Yan-Taihang Mountainous Contiguous Poverty-stricken Region. In 2016, a total of 0.03 million households (0.06 million persons of the county) were classified as poverty-stricken, and the poverty headcount ratio was 30.5%. This large share of the population beneath the national poverty line (of 2300 yuan per capita), as well as the large proportion of mountainous area (87.17%), have made

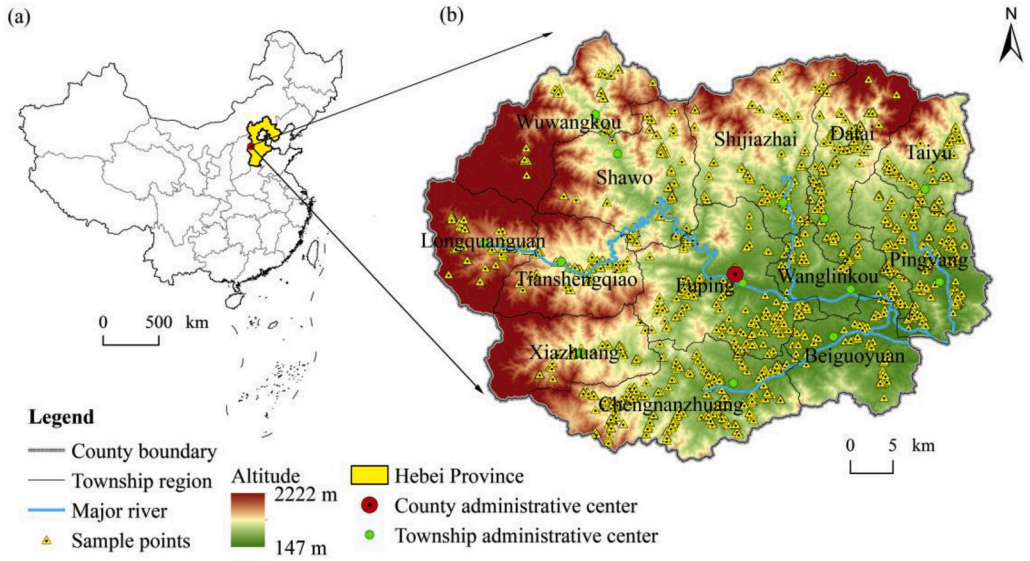

Fig. 1. Location of the study area and the sample points.

Fuping County a microcosm of China's rural poor areas and a typical representative of all 832 state-designated impoverished counties. Moreover, a rough statistic, conducted by the county employment department, showed that the total number of the working-age population in Fuping County was about 80,000 in 2016, among which outflowing migrant workers had a proportion of around 30% (nearly 24,000). Moreover, the number of inflowing migrants in the same year was lower than 4000. This disparity between outflow and inflow represents the one-way net loss feature and structural imbalance of the rural majority in this county. Therefore, the study area offers typicality and representativeness in the research and analysis of outflowing population from impoverished regions.

2.2. Data sources

The study data originated from questionnaire surveys and face-to-face interviews of poverty-stricken households, conducted in Fuping County in May 2016. The interviewees were limited to the householders of registered poverty-stricken families aged between 16 and 65 years old, and had to be non-students who were capable of labor working. In case the householder was not at home, other family members who are familiar with the circumstances were interviewed instead. The questionnaires solicited the general personal and family information (age, gender, education level, family size, and health condition), the employment status (employment type, employment destination, time for migrant work, and income structures), and the household living conditions (housing conditions, water safety, arable land area, and housing space). In addition, by field investigations, the geographical coordinates of each household were attained with the help of handheld GPS locators. Because of the lack and inaccuracy of a subset of the feedback information from site investigations, the final sample size for research and analysis involved 1449 registered poverty-stricken households. Each household had a unique GPS location, and all sample points were evenly distributed throughout the county, covering all 13 townships and 121 administrative villages (Fig. 1).

Spatial data on county boundaries and administrative centers were obtained from the National Geomatics Center of China (http://www.ngcc.cn/). The river network and land-use data were sourced from the Resource and Environment Data Cloud Platform (http://www.resdc.cn). Data on the medical and educational services POI (point of interest) were derived from the application programming interface (API) of Baidu Map.

2.3. Methodology

2.3.1. Theoretical framework

Assuming that the population element can freely and smoothly flow between urban and rural areas, the reaggregation of rural outflowing populations in different flow ranges can be regarded as a polarizing effect process. Consequently, after leaving the home village, the floating populations reaggregated at mainly four destinations ranks, namely destinations "within the township" (R-I), destinations "within the county (but out of the township)" (R-II), destinations "within the province (but out of the county)" (R-III), and destinations "out of the province" (R-IV). The higher the rank of the flow range (FR), the further the outflux distance (Fig. 2).

I represents the amount of floating populations. Among which, I_1 represents the population outflux from the home villages to places within the administrative township. In this case, people work nearby their home and typically still live at home. I_2 represents the population outflux from the home village to places outside the administrative township but within the county. Compared with I_1, the flow range of I_2 expands from the township to the scope of the whole county; thus, the

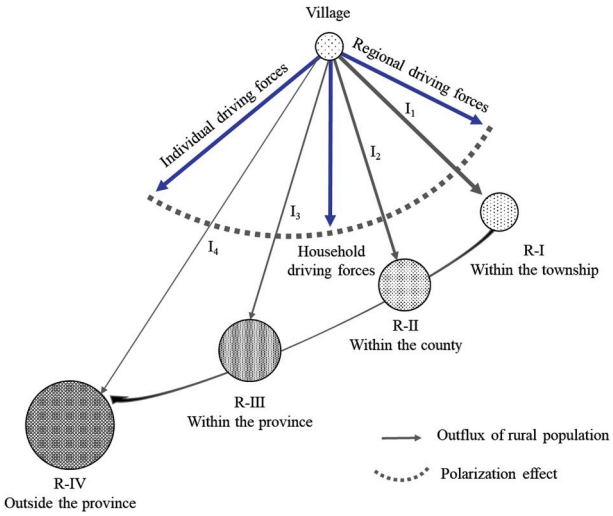

Fig. 2. Outflow ranges of the floating population and its main influencing factors.

rank of FR slightly increases. I_3 represents the population outflux from the home village to destinations out of the county but within the province. Here, people left the county to neighboring counties or cities in the province, to earn their income. I_4 represents the outflux from the home village to destinations outside the province, and corresponds to the maximum rank of FR. Under these specific circumstances, people are typically attracted by the metropoles in those urban agglomerations, and tend to stay longer and further away from their hometown.

2.3.2. Variable selection

Given the poor data access, issues about migration in rural China have not yet been well studied, especially in poverty-stricken regions. To explore the influencing factors of the FR, this study comprehensively referenced to the empirical judgments and conclusions of relevant research, which mainly focused on the features and mechanisms of migration and poverty phenomena in rural China (Chen, Wang, Zhao, Hu, & Duan, 2017; Li, 2009; Yang, Huang, Li, Qu, Gao, & Liu, 2018,). Furthermore, based on the knowledge gained from field investigations, several special indicators were considered, such as the housing security and living status of impoverished households, as well as their accessibility to basic public services. Of the various influencing factors of population floating, FR was selected as the explained variable, with three aspects of explanatory variables and 16 indicators. These factors correspond to the three types of driving forces in the theoretical framework above (Fig. 2): individual driving forces, household driving forces, and regional driving forces.

(1) FR. As posited in the theoretical framework, the FR of the floating population was divided into four ranks of ranges: destinations "within the township", "within the county", "within the province", and "outside the province".
(2) Individual factors. Five indicators were selected to reflect the influence of basic demographics and employment status: gender, age, education level, time for migrant work, and income from migrant work.
(3) Household factors. This aspect of variables consisted of five indicators, including the dependency ratio of family, basic living conditions, per capita net income of family, the family housing space per capita, and the family arable land per capita. Family ties have become one of the vital elements affecting the decision-making of rural households, such as employment choice. These variables enable the investigation of the relationship between household factors and outflow destination preferences of the rural poverty-stricken population to be discussed.
(4) Regional factors. Six spatial distance indicators were used to analyze the impact of geological location and basic public accessibility. All these indicators are based on the precise GPD locations of poor individuals and are: the "nearest distance to the major river in the county", the "distance to the administrative center of nearest township", the "nearest distance to the administrative center of the county", the "distance to the nearest medical facility", the "distance to the nearest primary school", and the "distance to the nearest middle school".

2.3.3. Ordinal logistic regression model

Logistic regression analysis is ideal to analyze individual decision-making behaviors ;(You, Yang, & Fu, 2018) Zhang & Han, 2018). Ordinal logistic regression models can be used to study the effects of different influencing factors (explanatory variables) on ordinal multi-categorical variables (explained variables) (Xue, 2013). In SPSS, five link functions are available to run the ordinal logistic regression model. Different link functions can be used for different distributed data. For instance, the Logit function is suitable for the estimation of evenly distributed categories. In Logit, when the explained variable Y has k categories ($k > 2$), the influences of all explanatory variables on each category can be expressed by the following formulas (Formulas 1-2):

$$Y = \mathrm{Logit}(k) = \ln\left(\frac{p}{1-p}\right) = \alpha_k + \sum_{i=1}^{m}\beta_i x_i \quad (1)$$

$$Pk = \frac{e^{\left(\alpha_k + \sum_{i=1}^{m}\beta_i x_i\right)}}{1 + e^{\left(\alpha_k + \sum_{i=1}^{m}\beta_i x_i\right)}} - \sum_{j=k-1}^{1} Pj \quad (2)$$

where p represents the p-value of the dependent variable (ranging between 0 and 1); x_i represents the independent variables; α_k represents the intercept parameters, and β_i represents the coefficient of x_i. P_k represents the probability of category k, and P_j represents the probability of category j ($j = k$ - 1). Since the data of this study met the requirements of Logit function, when conducting Logit, FR was regarded as the explained variable Y. The explanatory variables x_i consisted of 16 variables, and have been categorized into individual factors, household factors, and regional factors (see Table 1).

Table 1
List of variables for the ordinal logistic regression analysis.

Variables	Type	Explanation and assigned value
Flow range (FR)	Dependent	Within town = 1; Within county (and outside the town) = 2; Within province (and outside the county) = 3; Outside province = 4
Individual factors		
Gender (V_1)	Factor[2]	Male = 1; Female = 0
Age (V_2)	Covariate[1]	Population of working ages (16–64 years old); unit: years
Education level (V_3)	Factor	High school and above = 1; No more than middle school = 0
Time for migrant work (V_4)	Factor	No more than one season = 1; One to two seasons = 2; Two to three seasons = 3; Three to four seasons = 4
Income from migrant work (V_5)	Factor	Low (≤3000 yuan) = 1; Relatively low (3000–5000 yuan) = 2; Relatively high (5000–10,000 yuan) = 3; High (≥10,000 yuan) = 4
Household factors		
Dependency ratio of family (V_6)	Covariate	Ratio of elderly and underage population (<16 years or > 65 years) to the workforce population
Basic living conditions (V_7)	Factor	With both safe drinking water and housing = 1 Otherwise = 0
Per capita net income of family (V_8)	Factor	Low (≤3000 yuan) = 1; Relatively low (3000–5000 yuan) = 2; Relatively high (5000–10,000 yuan) = 3; High (≥10,000 yuan) = 4
Family housing space per capita (V_9)	Covariate	Ratio of family housing space and household registered populations; unit: m^2
Family arable land per capita (V_{10})	Covariate	Ratio of family arable land and household registered populations; unit: mu (1 mu equals 0.067 ha)
Regional factors		
Distance 1 (V_{11})	Covariate	Nearest distance to the major river in the county; unit: km
Distance 2 (V_{12})	Covariate	Distance to the administrative center of nearest township; unit: km
Distance 3 (V_{13})	Covariate	Nearest distance to the administrative center of the county; unit: km
Distance 4 (V_{14})	Covariate	Distance to the nearest medical facility; unit: km
Distance 5 (V_{15})	Covariate	Distance to the nearest primary school; unit: km
Distance 6 (V_{16})	Covariate	Distance to the nearest middle school; unit: km

Notes: 1) Covariate denotes continuous variables. 2) Factor refers to categorical variables.

3. Results and discussion

3.1. Comparison of influencing factors in different outflow ranges

In response to the range of migrant work, 784 (54.11%) farmers worked "within the township", 256 (17.67%) worked "within the county", 124 (8.56%) worked "within the province", and 285 (19.67%) worked "outside the province". The statistical results for the continuous and categorical variables in different flow ranges are summarized in Tables 2 and 3, respectively.

By comparing the mean values of each continuous variable in different outflow ranges, people who worked "within the township" were characterized by relatively older age (50.16 years old), higher housing space (36.61 m^2), larger arable land (0.57 mu), and lower family dependency ratio (45.90%). Those who worked "within the county" had a relatively higher family dependency ratio (54.39%), a further distance to the township administrative center (5.59 km), but nearer distance to the county administrative center (16.85 km). People who worked "within the province" had a relatively younger age (45.02 years old), and a further distance to the county administrative center (20.84 km). Outflow populations who worked "outside the province" could be characterized by a relatively nearer distance to the township administrative center (4.84 km), and a smaller housing space (32.36 m^2). These results indicate that: 1) Job-seekers with high family dependency ratio prefer to work "within the county" rather than "within the township" while taking care of other family members. 2) For younger migrants with less pressure to support a family, cities within the province are more attractive than the county center. 3) Elder poverty-stricken farmers tend to earn their livelihood on unstable *in-situ* jobs in combination with farming on the land.

Through comparative analysis of the proportion of each categorical variable in different outflow ranges, with the expansion of FR, the number of male migrants gradually increased, while the female decreased. Peasant workers who worked "within the township" had the largest proportion in both "no more than one season" (39.16%) and "low income from migrant work" (15.05%) categories; thus, they are characterized by relatively less working time, and lower migrant income. People who worked "within the county" accounted for the largest proportion in the "one to two seasons" (36.72%) category. Those who worked "within the province" had the largest proportion in the "two to three seasons" (12.90%) category. Moreover, people who worked "out of the province" accounted for the largest proportion in both "three to four seasons" (37.54%) and "high income from migrant work" (38.95%) categories; thus, they had a relatively higher migrant income by working longer and in more stable jobs far away from home. These findings suggested that: 1) The outflow ranges of floating populations are closely related to the average time for migrant work and the income from migrant work. 2) Outflow working helps to increase the income of farmers, but also accelerates the hollowing of rural young and middle-aged male subjects, which in turn leads to demographic imbalances.

Table 3
Statistics for categorical variables.

Categories	Within the town (%)	Within the county (%)	Within the province (%)	Outside the province (%)	Total (%)
[V_1 = 0.00]	748 (95.41)	246 (96.09)	120 (96.77)	278 (97.54)	1392 (96.07)
[V_1 = 1.00]	36 (4.59)	10 (3.91)	4 (3.23)	7 (2.46)	57 (3.93)
[V_3 = 0.00]	692 (88.27)	228 (89.06)	110 (88.71)	254 (89.12)	1284 (88.61)
[V_3 = 1.00]	92 (11.73)	28 (10.94)	14 (11.29)	31 (10.88)	165 (11.39)
[V_4 = 1.00]	307 (39.16)	75 (29.30)	29 (23.39)	34 (11.93)	445 (30.71)
[V_4 = 2.00]	253 (32.27)	94 (36.72)	44 (35.48)	98 (34.39)	489 (33.75)
[V_4 = 3.00]	76 (9.69)	33 (12.89)	16 (12.90)	46 (16.14)	171 (11.80)
[V_4 = 4.00]	148 (18.88)	54 (21.09)	35 (28.23)	107 (37.54)	344 (23.74)
[V_5 = 1.00]	118 (15.05)	19 (7.42)	11 (8.87)	11 (3.86)	159 (10.97)
[V_5 = 2.00]	32 (4.08)	8 (3.13)	0 (0.00)	2 (0.70)	42 (2.90)
[V_5 = 3.00]	142 (18.11)	31 (12.11)	16 (12.90)	23 (8.07)	212 (14.63)
[V_5 = 4.00]	492 (62.76)	198 (77.34)	97 (78.23)	249 (87.37)	1036 (71.50)
[V_7 = 0.00]	624 (75.59)	223 (87.11)	102 (82.26)	242 (84.91)	1191 (82.19)
[V_7 = 1.00]	160 (20.41)	33 (12.89)	22 (17.74)	43 (15.09)	258 (17.81)
[V_8 = 1.00]	90 (11.48)	12 (4.69)	9 (7.26)	11 (3.86)	122 (8.42)
[V_8 = 2.00]	208 (26.53)	69 (26.95)	27 (21.77)	55 (19.30)	359 (24.78)
[V_8 = 3.00]	303 (38.65)	102 (39.84)	56 (45.16)	108 (37.89)	569 (39.27)
[V_8 = 4.00]	183 (23.34)	73 (28.52)	32 (25.81)	111 (38.95)	399 (27.54)

Notes: 1) The number of samples is 1449.2) The sum of proportions is not always exactly 100%, because of the rounding of data.

3.2. Results of the ordinal logistic regression model

This study used the 16 variables that passed the collinearity diagnostics (tolerance > 0.1, VIF < 10.0) as dependent variables. The FR of the floating population was used as the independent variable for the ordinal logistic regression analysis. The model passed the parallel lines test and omnibus test, and the accuracy of model prediction was calculated by crosstabs as 55.62%. This study identified gender, age, time for migrant work, income from migrant work, dependency ratio of family, basic living conditions, per capita net income of family, family housing space per capita, nearest distance to the main river, distance to the administrative center of nearest township, and distance to the

Table 2
Descriptive statistics for continuous variables.

Variables	SD[1]	Max	Min	Mean				
				Total	Within the township	Within the county	Within the province	Outside the province
V_2	9.20	65.00	21.00	48.26	50.16	46.30	45.02	46.22
V_6	0.53	3.00	0.00	0.49	0.46	0.54	0.52	0.51
V_9	23.68	300.00	0.00	35.36	36.61	35.59	33.96	32.36
V_{10}	0.55	6.00	0.00	0.52	0.57	0.43	0.43	0.48
V_{11}	0.04	17.46	0.00	3.63	3.47	3.59	4.26	3.83
V_{12}	0.03	16.12	0.03	5.27	5.32	5.59	5.29	4.84
V_{13}	0.09	39.91	0.21	18.90	18.69	16.85	20.84	20.48
V_{14}	0.04	23.11	0.05	6.45	6.30	6.16	6.31	7.19
V_{15}	0.02	16.24	0.04	3.37	3.41	3.30	3.35	3.35
V_{16}	0.05	21.06	0.03	7.53	7.49	7.21	8.13	7.65

Notes: 1) SD represents the standard deviation of variables. 2) The number of samples is 1449.

nearest medical facility as significant driving forces that influence the FR of the floating population in rural impoverished regions. However, education level, nearest distance to the administrative center of the county, family arable land per capita, and distance to the nearest educational facilities (both primary school and middle school) did not significantly affect the FR. The following analysis is based on the regression results (Table 4).

3.3. Interaction analysis of the dominant determinants with the FR

3.3.1. Individual determinants of the FR

Gender affected the FR of the floating populations (Table 4). According to the questionnaire statistics, 80.70% of female respondents chose to work locally within the county, while the proportion of males was slightly lower, at 71.41% (Table 3). Setting the male category as reference, the FR rank of females was 0.61 times that of the reference group. In other words, without considering other factors, the female floating population was 1.63 times more likely to work nearby within the county than the male floating population. This result demonstrated that male labor force usually bears more pressure on supporting the family in poverty-stricken areas, and tends to flow further, and more frequently than the female labor force.

Age is a further influencing factor of the FR. The β-value of V_2 indicated a negative correlation between age and FR. Setting aside other factors, when ageing, people tend to work closer to their home villages. Statistical data of questionnaires testified that the proportion of respondents under the age of 30 who chose to work outside of the county was 60.71%; however, the same proportion of respondents aged 30–40, 40–50, 50–60, and above gradually decreased, with 34.94%, 31.92%, 24.64%, and 14.21%, respectively (Fig. 3). This result showed that age was negatively correlated with the FR. Older workers flow narrower than younger workers in the extent of range, which is likely attributed to the decrease of physical strength and health with increasing age. Another reason might be the shortage of professional skills, which limits the number of job opportunities available to older migrant workers in distant labor markets. Additionally, the proportion of respondents aged under 30 decreased with increasing FR from R–III to R–IV, which was mainly attributed to the lack of samples in this age group, and did not affect the findings presented in this section.

With regard to the time for migrant work the categories “no more than one season” and “one to two seasons” were two valid factors that affected the FR (Table 4). Using the category “three to four seasons” as reference, the FR of respondents whose working time was “no more than one season” was 0.42 times that of the reference group, and the FR of respondents who worked “two to three seasons” was 0.69 times that of the reference group. Data from questionnaires confirmed that 21.95% of respondents who worked no more than six months per year chose to work outside of the county, while the same proportion of respondents who worked no less than seven months per year was much higher at 39.61% (Fig. 4). This result indicated a significant positive correlation between the time for migrant work and the FR. The urban labor market generally offers a larger number of employment opportunities than the rural labor market. Because of that, a longer time for migrant work usually corresponds to a higher rank of the FR for rural migrants.

The p-value of the education level was not statistically significant and there the questionnaires did not produce valid evidence that the education level of a worker influenced his/her FR. This result is likely the result of the relatively low level of the overall education of workers, and the majority of the workforce had no higher than junior high school education (88.61%). However, the income from migrant work was statistically significant, and was positively correlated with the FR. Using the “high income” of migrant work category as reference, the rank of the FR in the “low income” category was 0.40 times that of the reference group, while the rank of FR in the “relatively low income” and the “relatively high income” were 0.41 times and 0.68 times, respectively. Therefore, excluding the influence of other factors, the higher the

Table 4
Parameter estimation results and fitting information of ordinal logistic regression.

Variables	B	Std. Error	Sig. (p-value)	Exp (β)	95% confident interval	
					Lower bound	Upper bound
[FR = 1.00]	−2.899	0.471	0.000***	0.055	−3.822	−1.976
[FR = 2.00]	−2.032	0.468	0.000***	0.131	−2.949	−1.115
[FR = 3.00]	−1.507	0.467	0.001***	0.222	−2.422	−0.592
[FR = 4.00]	0[a]	/	/	/	/	/
[V_1 = 0.00]	−0.488	0.292	0.095*	0.614	−1.061	0.084
[V_1 = 1.00]	0[a]	/	/	/	/	/
V_2	−0.043	0.007	0.000***	0.958	−0.057	−0.029
[V_3 = 0.00]	0.140	0.170	0.410	1.150	−0.193	0.473
[V_3 = 1.00]	0[a]	/	/	/	/	/
[V_4 = 1.00]	−0.856	0.158	0.000***	0.425	−1.165	−0.547
[V_4 = 2.00]	−0.375	0.139	0.007***	0.687	−0.647	−0.102
[V_4 = 3.00]	−0.232	0.179	0.194	0.793	−0.583	0.118
[V_4 = 4.00]	0[a]	/	/	/	/	/
[V_5 = 1.00]	−0.908	0.213	0.000***	0.403	−1.326	−0.490
[V_5 = 2.00]	−0.888	0.402	0.027**	0.411	−1.676	−0.100
[V_5 = 3.00]	−0.380	0.179	0.034**	0.684	−0.730	−0.029
[V_5 = 4.00]	0[a]	/	/	/	/	/
V_6	−0.245	0.124	0.048**	0.783	−0.487	−0.002
[V_7 = 0.00]	−0.342	0.143	0.017**	0.710	−0.622	−0.061
[V_7 = 1.00]	0[a]	/	/	/	/	/
[V_8 = 1.00]	−0.340	0.269	0.206	0.712	−0.867	0.187
[V_8 = 2.00]	−0.360	0.160	0.025**	0.698	−0.675	−0.046
[V_8 = 3.00]	−0.356	0.132	0.007***	0.700	−0.615	−0.096
[V_8 = 4.00]	0[a]	/	/	/	/	/
V_9	−0.007	0.003	0.013**	0.993	−0.012	−0.001
V_{10}	−0.120	0.113	0.289	0.887	−0.342	0.102
V_{11}	4.647	1.826	0.011**	104.272	1.067	8.226
V_{12}	−5.027	2.544	0.048*	0.007	−10.012	−0.042
V_{13}	−0.489	0.872	0.575	0.613	−2.198	1.219
V_{14}	4.318	1.683	0.010***	75.038	1.021	7.616
V_{15}	−1.736	2.765	0.530	0.176	−7.156	3.685
V_{16}	2.181	1.600	0.173	8.855	−0.956	5.318
Test of parallel lines - Null hypothesis general					Chi-square = 43.924	p = 0.475
Omnibus test					Chi-square = 214.239	p = 0.000
Goodness of fit - Pearson					Chi-square = 4449.983	p = 0.085
Goodness of fit - Deviance					Chi-square = 3172.955	p = 1.000
Pseudo R square - Cox and Snell					/	p = 0.137
Pseudo R square - Nagelkerke					/	p = 0.152
Pseudo R square - McFadden					/	p = 0.063

Notes: 1) The utilized link function was Logit. 2) *, **, and *** represent significance levels at 10.0%, 5.0%, and 1.0% respectively.

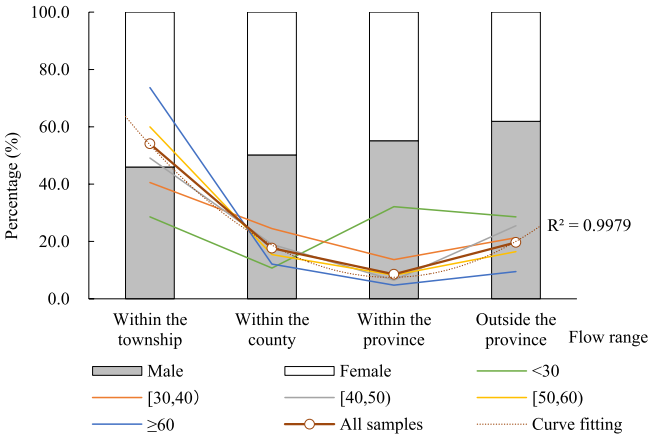

Fig. 3. Demographic characteristics of the floating population.

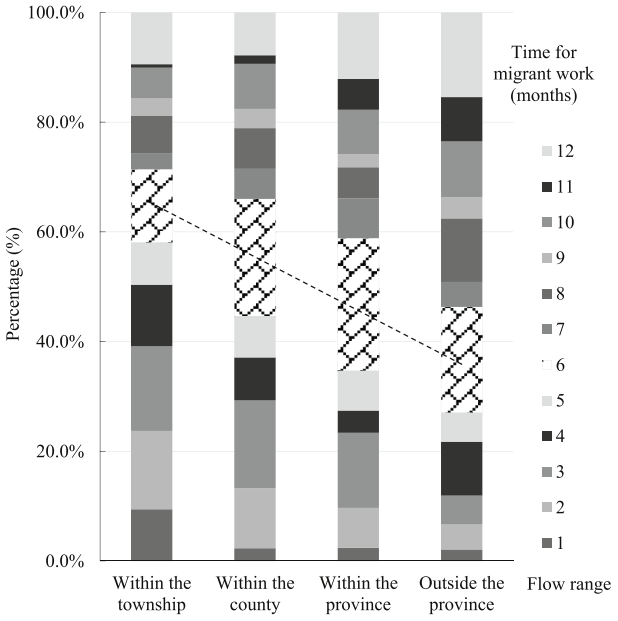

Fig. 4. The relationship between outflow range and time for migrant work.

income from migrant work, the higher the ranks of the FR. Questionnaire statistical data showed that the average annual income for migrant workers (outside the county) is 1.37 times that of a local worker (inside the county). This result implied that the higher income offered by big cities and metropolises outside the countryside is likely an important driving force for the outflow of rural population.

3.3.2. Household determinants of the FR

The *p*-value of the dependency ratio of family was statistically significant, and a negative correlation was found between the dependency ratio of family and the FR. Assuming that all other factors remain the same, the higher this ratio was, the lower the rank of the FR. This result is inconsistent with empirical judgement in that people with a higher family dependency ratio are more likely to work closer to home than migrant workers to raise family income. This finding is most likely because these poverty-stricken households consisted of more non-self-supporting persons such as children, elder parents, and disabled who require company and care.

The basic living conditions provide another significant influencing factor for the FR. Safe drinking water and housing are the most basic guarantees for survival for a rural impoverished family, and both are indispensable. Using respondents with "double guarantees" as reference, the odds value of "otherwise" was 0.71 times that of the reference group. This finding is similar to the previous factors (V_6) in that worse basic living conditions, lead to a weaker willingness of floating populations to flow far to earn a better life. Statistics of these questionnaires indicated that poverty-stricken populations with either one of these two guarantees are poorly educated with no more than junior high school education (90.21%). This might explain the above controversial result why respondents in the "otherwise" category tended toward *in-situ* employment within the county rather than seeking outside employment, because they were less able to engage in higher-income jobs in the outside urban work market.

With regard to the per capita net income of family, the *p*-values of "relatively low income" and "relatively high income" were both statistically significant. Using the "high income" category as a reference, farmers with an annual per capita net income between 3000 and 10,000 yuan were 1.43 times more likely to work nearby within the county than those in "high income" group. The data of the questionnaire showed that the proportion of respondents with no more than 3000-yuan per capita net income and who worked within the township was 73.77%, while the same proportion of the other three flow ranges gradually decreased from 57.94% to 53.25% and 45.86% (Fig. 5). Moreover, those low-income respondents had a higher family dependency ratio of 0.58 compared with the other respondents (0.48). These findings provide strong evidence for the reasons why impoverished farmers with less per capita net family income would rather work nearby than migrate outside the county, as an influence of the family burden.

The *p*-value of the family housing space per capita (V_9) was statistically significant as well, while were no adequate demonstrations pointed to a direct correlation between the FR and the family arable land per capita. Farmers with larger areas of arable land are supposed to have a higher possibility to stay home to earn their life on the land. However, the area of arable land in mountainous regions like Fuping County with no more than one mu per capita (at 0.06 ha per capita), is insufficient to feed all the poverty-stricken farmers. That is probably the main reason why individuals differ insignificantly in V_{10}. The β-value of V_9 indicated the negative impacts of family housing space per capita with the FR. This result demonstrated that setting aside the other factors, the FR can be ranked lower for individuals with larger housing space. The general situation gain from field investigation in the study area might account for this result, since farmers with better living conditions typically have more than one residential and larger housing space. Thus, they have lower demands for higher-income opportunities far away from home.

3.3.3. Regional determinants of the FR

The *p*-values of the "nearest distance to the major river in the county" (V_{11}), the "distance to the administrative center of nearest township" (V_{12}), and the "distance to the nearest medical facility" (V_{14}) were statistically significant (Table 4). Among these three variables, the β-value of V_{11} was positively correlated with the FR. That is, when all other factors remain the same, the closer the nearest distance of individuals to the major river in the county, the higher the FR ranks. This finding is associated with the spatial distribution of the main rivers in the study area. Major rivers are flowing through eight of 13 township centers in Fuping County, including the center of the county town (Fig. 6). These were the places where the rural permeant population aggregated. Hence, the shortage of available water resources caused by population agglomeration was likely the main reason for this result.

The β-value of V_{12} indicated a negative correlation with the FR. Assuming all other factors remain the same, the FR ranked lower for individuals living near a township center than those living remotely. This result showed that as long as job opportunities near local township centers are plentiful, people would rather choose to stay at home over *in-*

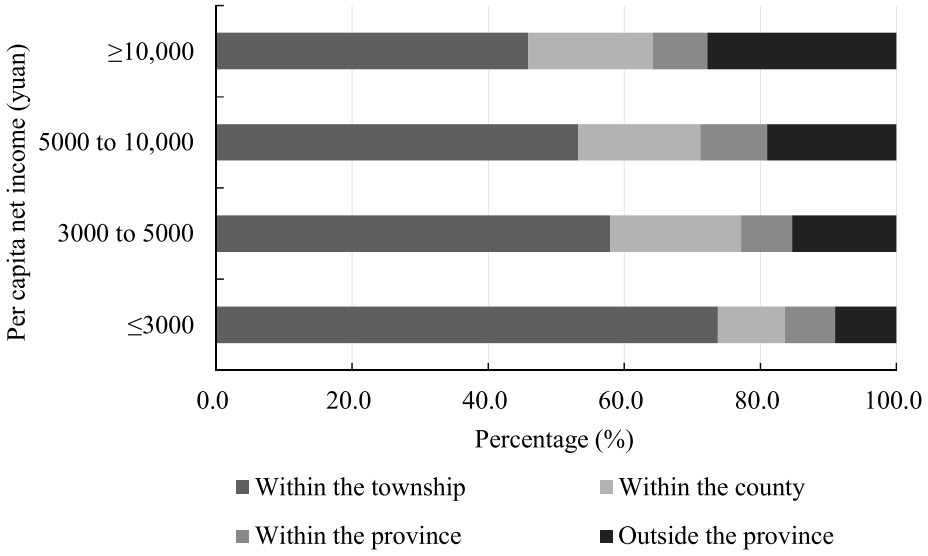

Fig. 5. Relationship between outflow range and per capita net family income.

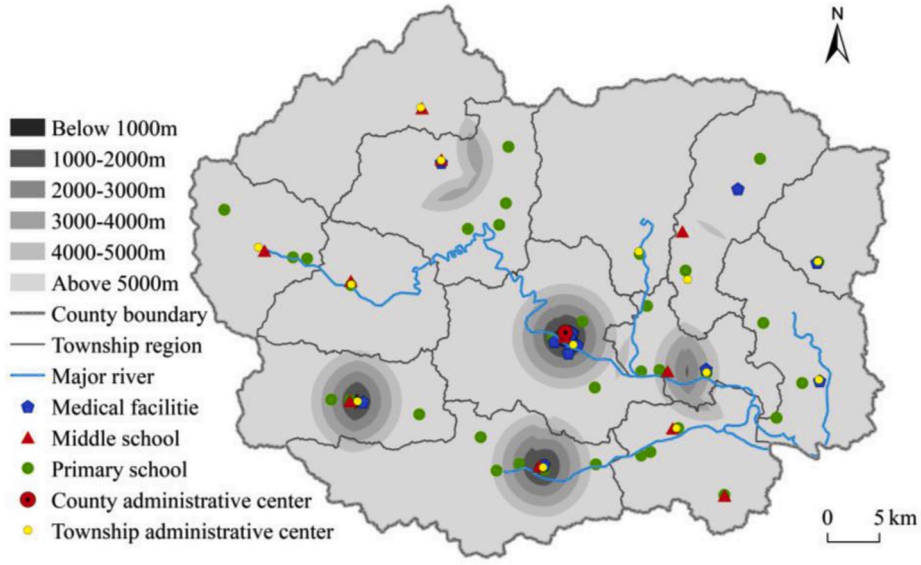

Fig. 6. Intersection buffers of medical treatment and educational services in Fuping County.
Notes: Medical treatment facilities were carefully screened, and refer to public hospitals and township health centers with specific qualifications. Those private clinics with no professional medical staff, and pharmacies mainly selling health products and medical devices were removed from the final list.

situ employment. Compared with V_{13}, the *p*-values of the "nearest distance to the administrative center of the county" (V_{13}) was not significant. This is likely because of the convenience of transportation near the county town, which equips people with more flexibility for employment choices, and weakens the impacts of distance factors.

The "distance to the nearest medical facility" (V_{14}) is another significant geographical location factor that affects the FR. The β-value of V_{14} indicated a positive correlation with FR; thus, the more convenient the access to medical services, the higher the rank of FR. In contrast, neither the "distance to the nearest primary school" nor the "distance to the nearest middle school" were statistically significant. Individuals with more convenient to access educational and medical treatment facilities, were more likely to send their children to nearby schools and choose *in-situ* employment. Nevertheless, the level of medical and educational services has not yet become the valid driving force for the FR. To further explore the reason for these results, this study assumed each educational and medical service facility in the study area as center, drew buffers covering six scopes from 0 to 5000 m, and extracted the intersecting areas of these buffers (Fig. 6). This showed that there were only three gathered cores of basic public services in Fuping County, where inhabitants can get access to both relatively convenient educational and medical public services. Therefore, the main reason for these results might be the recessive development level of basic public services in rural areas, especially in impoverished rural regions that have been trapped in the dilemma of public resources scarcity for a long time.

4. Conclusions and policy implications

This study focused on the floating populations in poor areas and analyzed the characteristics and determinants of different outflow ranges, based on the data derived from site investigations in Fuping County. By using an ordinal logistic regression model, this study explored the driving mechanisms of the FR from three perspectives, namely individual factors, household factors, and regional factors. The

results showed the following:

By comparing the influencing factors in different outflow ranges, this study found suggestive evidence that different groups of job-seekers varied in their preference of employment choices. For instance, older poverty-stricken farmers tended to earn their livelihood via unstable *in-situ* jobs, while younger migrants with lower pressure to support a family are more likely to be attracted by the high-income job opportunities in urban markets outside of their county of origin. In addition, the quantity of the outflow population in the four FR followed a decreasing trend first, followed by an increasing trend, which constituted a typical U-shaped pattern. After leaving their home villages, the majority of the floating population mainly clustered in township centers inside the county (54.11%) and those metropolis outside the province (19.67%), while skipping over the county town (17.67%) and the urban regions within the province (8.56%).

The U-shaped curve of the floating population reflected the "agglomeration shadow" phenomenon around metropolises (Chen & Sun, 2017; Sun, Zhang, Hu, Zhou, & Yu, 2013; Zhang & Zhuang, 2000). Because of the district economic imbalance, within a specific region, when the "pull" force from central cities exceeded that generated by other sub-centers, this is likely to create a less-developed "valley" surround them, which was found for the study area. This research confirmed that Fuping County is located in the metropolitan shadow of the Beijing–Tianjin–Hebei urban agglomeration, and for a long time, faced the crisis of talent loss. In 2016, the per capita net income of rural residents in Fuping County was 5815 yuan, which was 26.06% of that of Beijing City, 28.96% of Tianjin City, and 48.79% of Hebei Province. These gaps might be the main reasons for driving the rural job-seekers towards metropolises such as Beijing and Tianjin, rather than county towns or urban regions in Hebei province such as Baoding City and Shijiazhuang City. These findings also reflected the failure of existing efforts to encourage the growth of small cities and towns, and showed that big cities still face overwhelming sprawl after absorbing the massive rural migration form impoverished regions.

When verifying the driving mechanisms in the theoretical framework, adequate empirical evidence indicated that many individuals, households, and regional influencing factors mattered for the FR. With regard to the individual factors of the FR, gender, age, time for migrant work, and income from migrant work were identified as important driving forces of the FR, while education level did not significantly affect the FR. With regard to household factors, the results showed that the dependency ratio of family, basic living conditions, per capita net income, and housing space per capita were significantly corelated with the FR, while the family arable land per capita did not significantly affect the FR. From the perspective of regional factors, the findings suggested that the nearest distance to the main river, township administrative centers, and medical facilities greatly influenced the FR; however, the nearest distance to the administrative center of the county and educational facilities were not significant influencing factors of the FR.

In contrast to the results of a previous study (Hu, Xu, & Chen, 2011), the floating population with high dependency ratio, poor basic living conditions, and less per capita income, would rather stay home and seek *in-situ* employment than circulate far away to earn better wages; thus, their FR ranked low. Farmers are typical risk-averters (Li, 2009), especially those who are stuck in poverty, and instinctively chose the most appropriate work destinations to minimize unanticipated risks, as long as they provide the most basic survival needs. However, migrants with good housing conditions (i.e., large housing space) at their home location tended to spend more time in local employment. This result contrasted with that of a previous study (Chen & Cindy, 2018) and identified a spatial mismatch between high-income demands and high-income opportunities. The analysis of this research confirmed that factors such as household ties and basic living conditions restrained a certain amount of rural labors from moving to urban regions.

Several findings were in accord with previous studies (Chen & Cindy, 2018; Lin & Zhu, 2014), corroborating that the floating population was dominated by a young and middle-aged male workforce, characterized by a low level of education. Thus, in poverty-stricken regions such as Fuping County, the outflux of floating population leads to a demographic-structural imbalance of rural subjects, with the exception of the demographic quantity loss. Moreover, the FR of floating population proved to be closely related to the average time for migrant work and the income from migrant work. Famers with more free time available for migrant work corresponded to higher ranks of the FR. This result coincided with previous studies (Zhao, Su, & Sheng, 2014) in that migrant workers far from home rarely go back, except for the Chinese New Year Festival; and thus, they bore less instability than local employment.

Spatial determinants based on precise GPS locations further verified the impacts of reginal factors on the FR. These demonstrated that township centers played more essential roles in the reaggregation of floating population, compared with county centers. Township centers are premier agglomeration cores of the rural labor force in the four outflow ranges, and laborers trapped in poverty would rather stay at home and choose nearby employment than choose displaced migrant work, as long as there are sufficient *in-situ* job opportunities. Other regional factor such as the quantity and quality of basic public services were found to have not yet become the valid influencing factors of the FR, which mainly because of the scarcity of public resources in poverty-stricken regions. On that occasion, the recessive development of medical and educational services could hardly sustain the demand of the local permanent population, let alone drew the back-flow of output migrants. These findings provided empirical evidence for the causes of rural poverty in that poor geological locations would not only explain the relative poverty in remote mountainous regions (Wang, Liu, & Li, 2018) but also drive the outflow of floating population, which in turn accelerates the hollowing of rural subjects and intensify their poverty.

These results and conclusions suggest several possibilities for policy implications in impoverished regions with the aim to alleviate rural poverty, promote urban-rural integration, and realize rural revitalization:

Considering the employment preference and actual demands of the floating population, local governments at the county-level are expected to strengthen the spatial planning and functional division of townships. Several central towns should be established, to cultivate local characteristic industries, and create a substantial number of *in-situ* employment opportunities. Moreover, to ease the demographic-structural imbalance caused by the outflux of young and middle-aged laborers, local employment departments should formulate entrepreneurship incentives with the aim to attract the back-flow of migrant workers. These returning populations will inject new vitality into rural regional systems and will thus become the main body of the required rural revitalization.

The most fundamental cause of this relative poverty is the persistent social-economic gap between urban and rural regions, especially between the metropolitans and their surrounding impoverished countryside. Thus, more attention should be focused on the construction of urban-rural infrastructure networks, which provide a platform for the equal and smooth circulation of constituent elements such as population, land, industry, capital, information, and technology. This goal is by no means a simple matter to be solved within a short time, and requires the coordination of both urban and rural sectors, as well as the combination of market mechanisms and government regulation.

Considering the reference significance of this study for other counties that are stuck in rural poverty and poverty-developing countries, more public resources and scientific research should focus on the study and analysis of poverty mechanisms. Just as no two places in the world are exactly the same, the causes of rural poverty also vary from region to region. With regard to poverty-stricken areas on the periphery of urban agglomeration such as Fuping County, the main cause of poverty is the siphon effect of urban regions, which gradually drain the resources of the surrounding countryside and thus increase the urban-rural gap. Other types of rural poverty may be attributed to historical policies,

functional zoning, land degradation, or something else. Each type of poverty requires joint efforts of different solutions for the underlying causes.

In this paper, the spatial determinants based on individual GPS locations were integrated in the analysis of the driving mechanism of the flow population, and compensated for the deficiency of relevant micro-scale studies. Future research needs to investigate other determinants such as farmers' psychological needs, social network, and transportation accessibility. The backflow mechanism and environmental influences of floating population are worthy of further analysis.

CRediT authorship contribution statement

Yifan Wu: Conceptualization, Methodology, Visualization, Writing - original draft, Writing - review & editing. **Yang Zhou:** Resources, Data curation, Investigation. **Yansui Liu:** Supervision, Project administration, Funding acquisition.

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